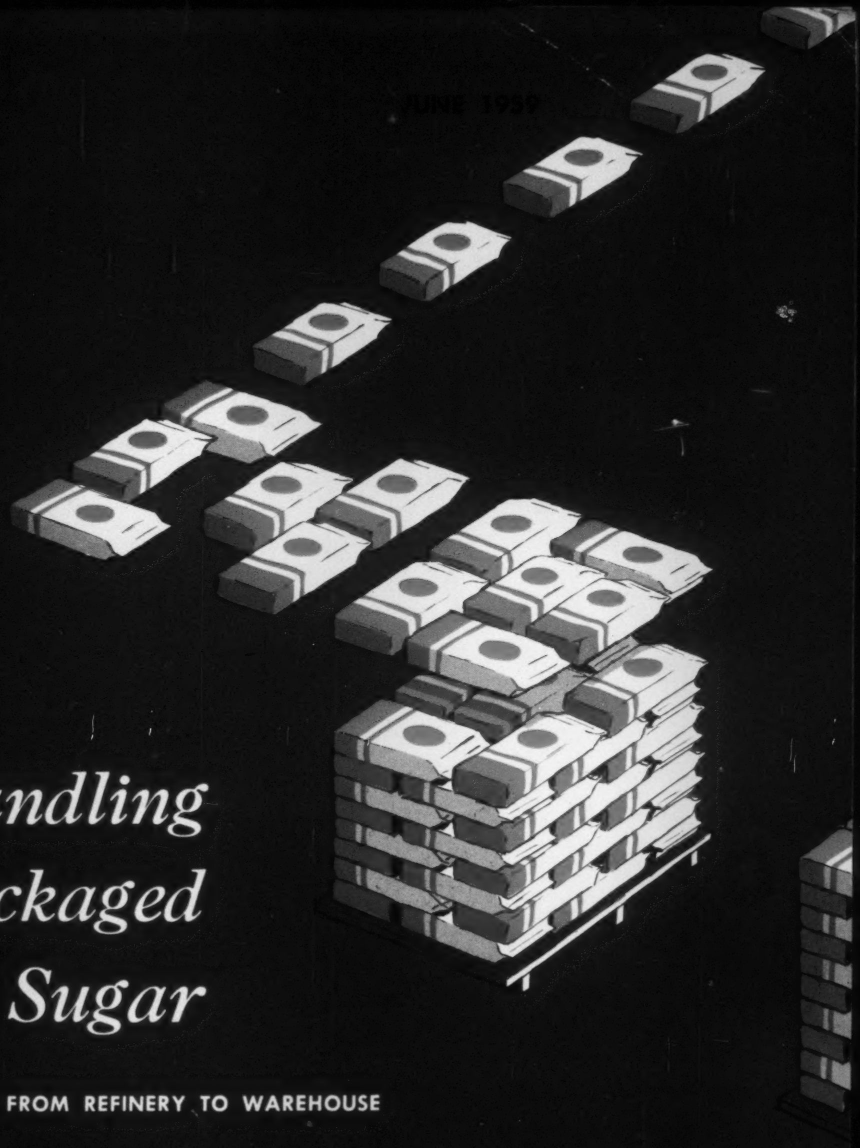
AUTOMATION

JUNE 1959



Handling Packaged Sugar

FROM REFINERY TO WAREHOUSE

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS

- ▸ **Developing Unique Equipment**
- ▸ **Programming for Numerical Control**
- ▸ **Designing Control Panels**
- ▸ **Cards Control Assembly**

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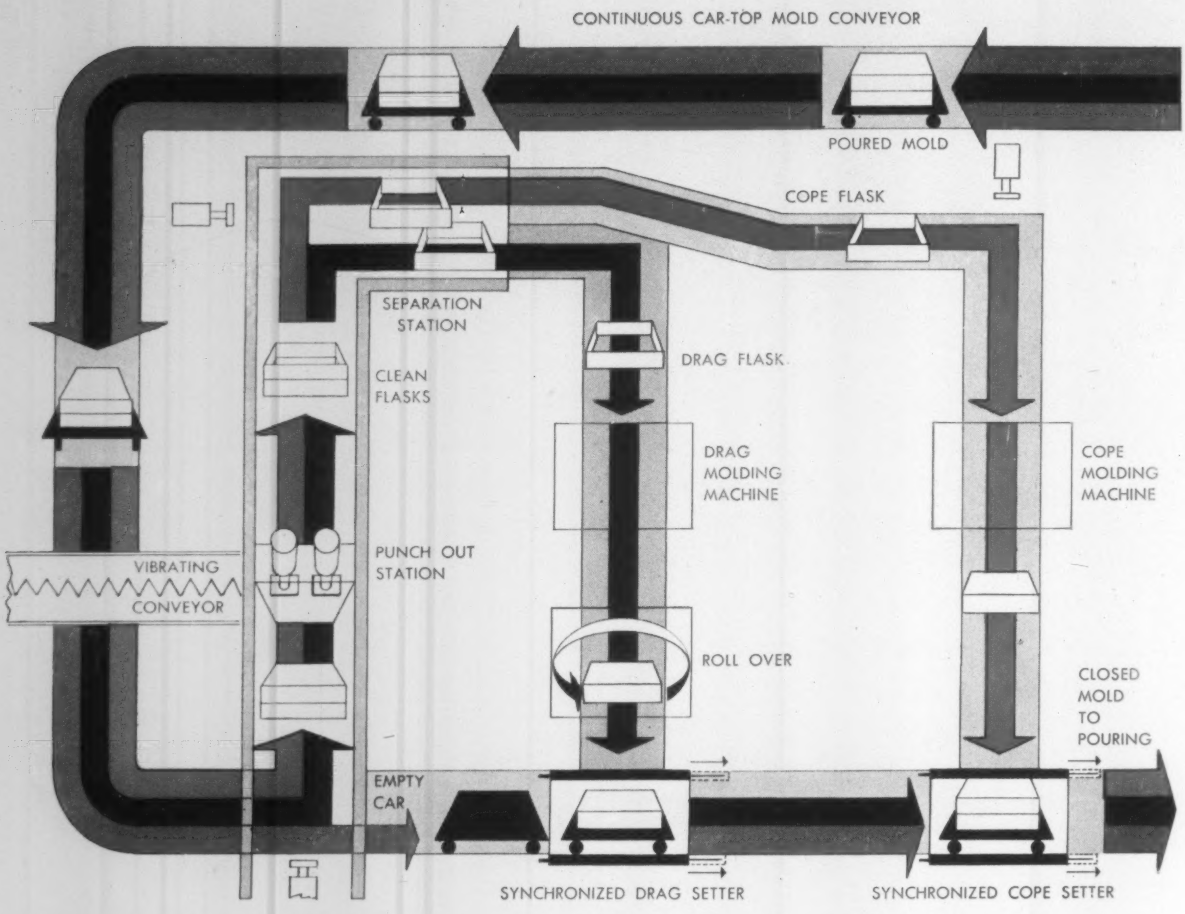
A PENTON PUBLICATION


CONTINUOUS CAR-TOP MOLD CONVEYOR
POURED MOLD
COPE FLASK
SEPARATION STATION
CLEAN FLASKS
DRAG FLASK
DRAG MOLDING MACHINE
COPE MOLDING MACHINE
VIBRATING CONVEYOR
PUNCH OUT STATION
ROLL OVER
CLOSED MOLD TO POURING
EMPTY CAR
SYNCHRONIZED DRAG SETTER
SYNCHRONIZED COPE SETTER

NEW AUTOMATIC MOLD HANDLING SYSTEM

..ANOTHER EXAMPLE OF PLANET VERSATILITY

Custom designed systems, such as the automatic mold handling system shown in the above diagram, have helped build Planet Corporation's reputation throughout industry as a *versatile* organization . . . as an organization with solutions to the most perplexing production, materials handling and automation problems.

This system, installed in a large automotive foundry, automatically handles molds from start to finish. After molding, the drag and cope flasks are brought together and gently and accurately closed in position for pouring. Following pouring, the castings and sand are punched out, the clean flasks are separated and recirculated through the system . . . *a system which will pay for itself in less than one year.*

This is only one example of "PV" . . . *Planet Versatility.* Planet "PV" engineers have automated many types of production lines, built bulk and unit materials handling systems, designed complete plants, developed the world's only true universal transfer device . . . in fact, they are experts on all types of special handling and automation machinery, and materials handling equipment.

No matter what your problem . . . no matter how big or difficult your problem, "PV" will save your time in finding cost-saving, efficiency-increasing solutions. Let Planet demonstrate how its versatile engineering skill, and production and erection know-how can help you . . . you'll find *it pays to plan with Planet.*

PLANET
CORPORATION
910

- Engineered Handling Systems
- Automation Equipment
- Mill & Foundry Handling Equipment

1810 SUNSET AVENUE
LANSING, MICHIGAN

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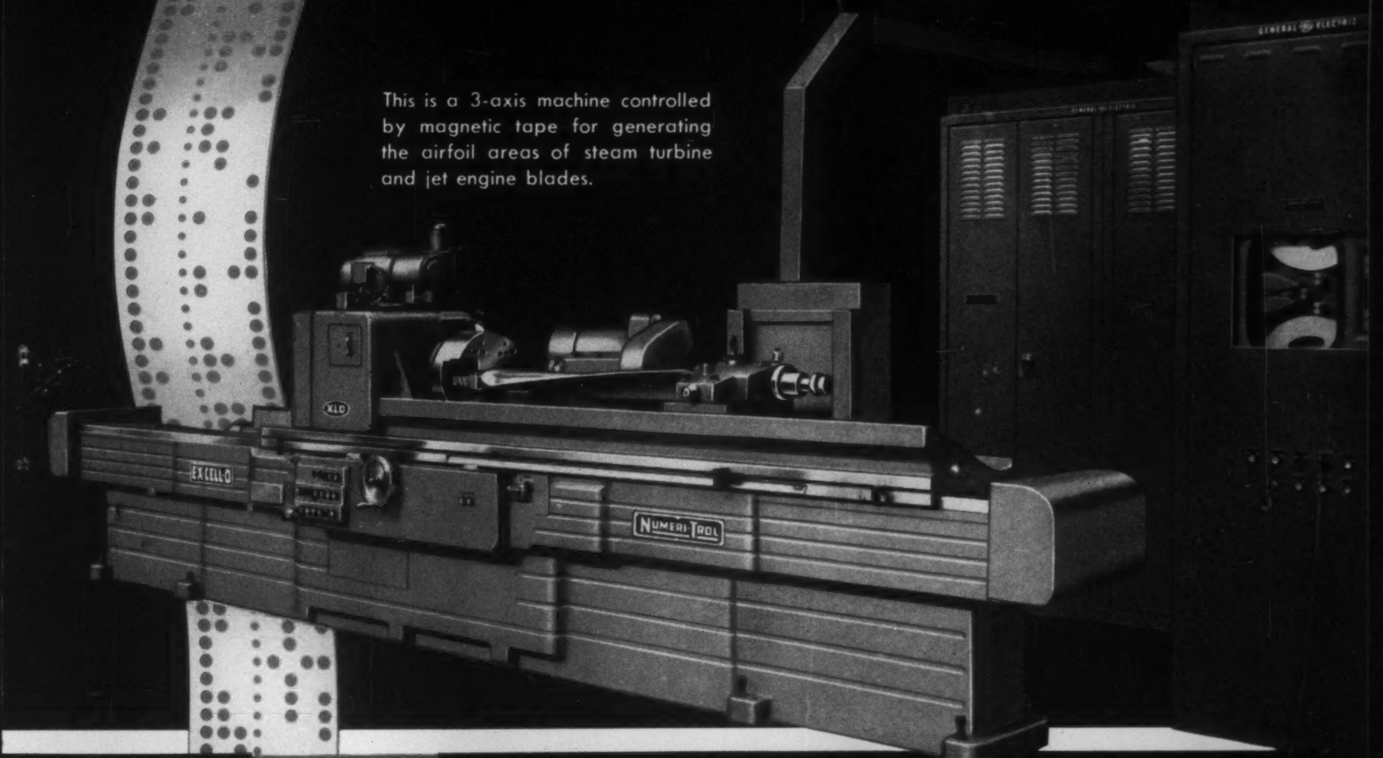
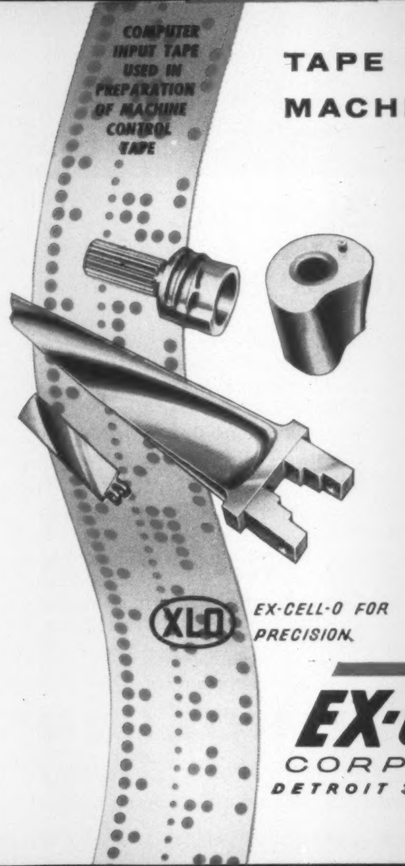

This is a 3-axis machine controlled by magnetic tape for generating the airfoil areas of steam turbine and jet engine blades.

NUMERI-TROL

59-3

TAPE CONTROLLED PRECISION PROFILING MACHINES BY EX-CELL-O


COMPUTER INPUT TAPE USED IN PREPARATION OF MACHINE CONTROL TAPE

FIRST to provide 360° work rotation for 3-dimensional machining of complex parts

FIRST to combine grinding, dressing and dressing compensation with milling

Numeri-Trol puts a new dimension into machining. Lead time goes down, tooling costs and machining time are cut in production of prototypes and complicated precision parts. Lateral movement of the work head and transverse travel of the cross slide combine with rotary work feed to permit milling and finish grinding impossible or uneconomical by ordinary standards. Wheel dressing and dressing compensation are fully tape-controlled. Numeri-Trol machining includes rotary and longitudinal milling with automatic work feed and 360° indexing.

Have a part that is costing too much to make? Find out how Numeri-Trol can produce it—economically! See your Ex-Cell-O Representative or write direct.

XLO *EX-CELL-O FOR PRECISION*

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

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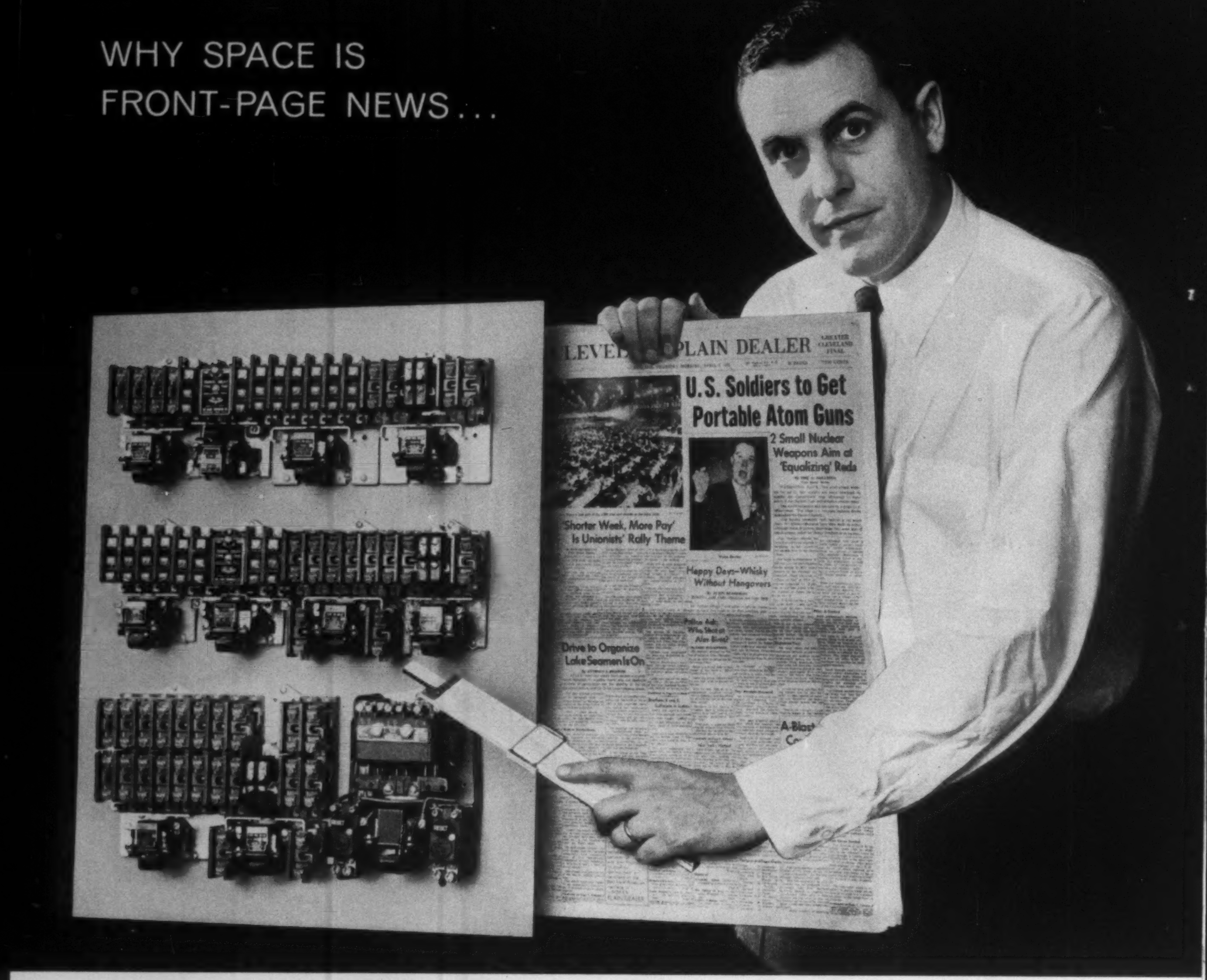
WHY SPACE IS
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LEVEL PLAIN DEALER
U.S. Soldiers to Get
Portable Atom Guns
2 Small Nuclear Weapons Aim at 'Equalizing' Reds
'Shorter Week, More Pay' Is Unionists' Rally Theme
Happy Days—Whisky Without Hangovers
Drive to Organize Lake Seamen Is On
A-Blast

Compact Clark Relays control 72 circuits from panel area smaller than a newspaper

In this day of space exploration and space economy, it's news—front page news—when you can get 72 separate, controlled circuits all on a panel no larger than 15" x 20".

Clark Controller, with the most complete and integrated line of control relays available today—convertible pole, latch, universal pole, and time delay—does it! And only Clark offers such a wide range of operation, so many contacts, in a panel area of such small size.

Shown mounted here with the Clark Size 1, Type "CY" Starter are 10 compact Clark Relays which include four time delay contacts (two normally open, two normally closed), 52 instantaneous contacts (14 normally open, 14 normally closed, and 24 convertible), plus 16 latching contacts (all convertible).

The same engineering leadership and superior workmanship that made Clark Controller the *standard of quality* for controls in heavy industry, is inherent in the broad line of Clark Relays for modern panels.

The "modular construction" of all Clark "PM" Relays insures integrated uniformity, compactness and flexibility. Functional alignment in mounting results in neater, more uniform panels and most efficient utilization of valuable space. And because "PM" relays are available in a wide variety of pole combinations, providing up to 14 contacts on a single relay, you can control more circuits—save on relay requirements.

For more information on the complete line of Clark "PM" Relays which is making space-saving headlines, contact your nearest Clark Controller sales office or distributor. Or, write direct to Clark Controller for free bulletins.

The
CLARK CONTROLLER *Company*
Everything Under Control • 1146 E. 152nd St. • Cleveland 10, Ohio
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JUNE 1959
Vol. 6—No. 6

AUTOMATION®

A PENTON PUBLICATION

The Magazine of Automatic Manufacturing Operations

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automation outlook

UNPARALLELED GROWTH

". . . almost the entire world is in a growth period such as never before known in history. The modern technological age is penetrating everywhere. Industrialization and mechanization are the present aims of nearly every world government. This will continue to provide immense new markets . . . such as never existed before. It will take years, generations, for most parts of the still undeveloped areas of the world to catch up. . ."—*Dudley T. Colton, vice president & general mgr., Johns-Manville International Div., Johns-Manville Corp.*

OPPORTUNITY TO AUTOMATE

". . . aluminum has been, up to now, a job-shop industry. It has been supplying a little bit of this and a little bit of that. This means relatively short runs of hundreds of combinations of alloy, temper, gage, size, and form. The can market represents one of the first opportunities for the aluminum industry to achieve new standards of low conversion cost for aluminum can-making materials . . . aluminum should capture about 5 per cent of the 40-billion-unit can market in the next 3 to 5 years, and may win up to 20 per cent in the next 10. . ."—*L. R. Payton, mgr., Rigid Container Div., Reynolds Metals Co.*

INTEGRATED OPERATIONS

". . . what we are looking for is the automatic paper work factory connected by machines to the automatic goods-producing factory, with a minimum of humans in the loop from inputs to outputs. . ."—*John D. Dillon, president, Vanguard Associates Inc.*

JOB FOR A COMPUTER

". . . it is amazing how little the average merchant knows about the buying habits and preference of his customers . . . and the trends in his locality . . . The information required for merchandising involves the calculation of trends, comparisons with previous years, relationship with other merchandise. These are calculations which a computer is best suited to perform. . ."—*Ethel Langtry, research director, Retail Research Institute, Div., National Retail Merchants Association.*

PRICE OF INFLATION

". . . new machines almost invariably are more efficient than the old and thus contribute toward getting our job done at lower cost, but the fact remains that on the average they cost three times as much. Thus the money invested in our business on which we must earn an adequate return keeps going up. This is a part of the price we as a Company pay for inflation. . ."
—*Arthur B. Goetze, late president, Western Electric Co. Inc.*

PROGRESS IN STANDARDS

". . . our own U. S. Congress, in 1866, specified that in 1 meter there would be 39.37 inches, but in one centimeter there would be 0.394 inches, apparently believing that the third decimal place was as far as anyone would have any occasion to go. Maybe we have gone too far, but at least in attempting to measure to 0.1 millionth, we are able to measure to millionths more accurately. . ."—*Albert M. Dexter Jr., dir., Metrology, Pratt & Whitney Co. Inc.*

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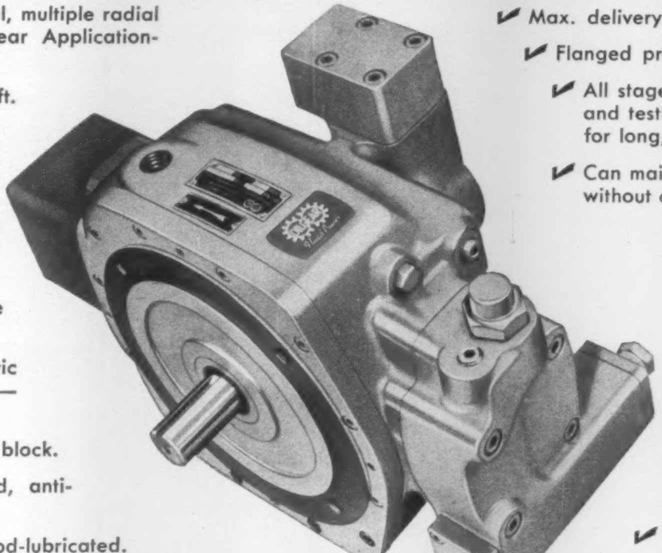
BPA NBP

. . . *Fluid Power* **news**

NEW RADIAL PISTON VARIABLE DISPLACEMENT PUMP

OILGEAR ANNOUNCES NEW "*Power-Saver*" PUMPS

New Type "ANP" Pumps Generate Only Needed Power — Boost System Efficiency

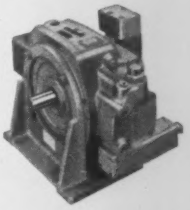


- ✓ Simple, one piece, alloy steel, multiple radial rolling pistons — an Oilgear Application-Proved, exclusive design.
- ✓ One-piece cylinder and shaft.
- ✓ Balanced flat valve (port plate) and separate wear plate to assure a controlled oil film between working surfaces . . . high volumetric efficiency over entire pressure range.
- ✓ Integral, adjustable volume control.
- ✓ Integral, adjustable, automatic pressure unloading control — 200 to 1100 psi.
- ✓ Precision, bearing-type slide block.
- ✓ Large, conservatively loaded, anti-friction bearings.
- ✓ Completely pressure and flood-lubricated.
- ✓ Working pressure range — 200 to 1100 psi.
- ✓ Built for continuous, full-load service on pushing, pulling, lifting, lowering applications . . . on machines requiring positive, static loads over intermittent or long periods . . . for automatic charging of accumulator systems . . . for repetitive "ON-OFF" loads up to 1100 psi. New Oilgear type "ANP" pumps will perform more efficiently — with less heat generation — on presses, machine tools, transfer machines, hold-downs, injection molding, die casting — and other machines.
- ✓ Max. delivery to 3100 cipm (13½ gpm).
- ✓ Flanged pressure and suction ports.
- ✓ All stages of manufacturing, assembly and testing under strict quality control for long, dependable service life.
- ✓ Can maintain a static load indefinitely without overload or excessive heating.
- ✓ Adjust pump volume to suit optimum ram speed — no excess oil to "wire-draw," blow past a relief valve or generate heat.
- ✓ Adjust pressure to maximum force needed. When this preset pressure is reached, control automatically reduces pump to slip stroke to save power — reduce heat.
- ✓ Available clockwise or counterclockwise rotation at no extra cost.

SELECTION OF MOUNTINGS

Pump case has an accurately finished round face for:

1. Mounting direct to machine. (above)
2. Mounting to a right-angle bracket for "foot-mounting." (right)
3. Mounting to a round adapter for NEMA type "C" electric motor frames.
4. As Standard and "Custom-Built" "Power-Paks"—(right) . . . . complete, compact sources of Fluid Power. Standard "Pak" consists of "ANP" Pump with round adapter or right-angle bracket, coupling, electric motor, 23-gallon differential capacity welded steel base, piping, air breather, filling strainer, fluid level gauges, baffles, clean-out covers, drain plugs, auxiliary pipe connections, and mounting and leveling lugs.



Oilgear's "*Power-Saver*" Pumps and simplified circuitry reduces engineering, production and assembly costs . . . promotes safety, improves performance and system efficiency.

NEW

OILGEAR

variable displacement pump

Power Saving Control

you save power reduce heat

you reduce costs

THE OILGEAR COMPANY

For complete data on these new "Power-Saver"—Oilgear type "ANP" Pumps — call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, requesting your copy of Bulletin 47550 — stating your specific requirements directly to . . .

THE OILGEAR COMPANY

Application-Engineered Controlled Motion Systems

1598 WEST PIERCE STREET ◦ MILWAUKEE 4, WISCONSIN

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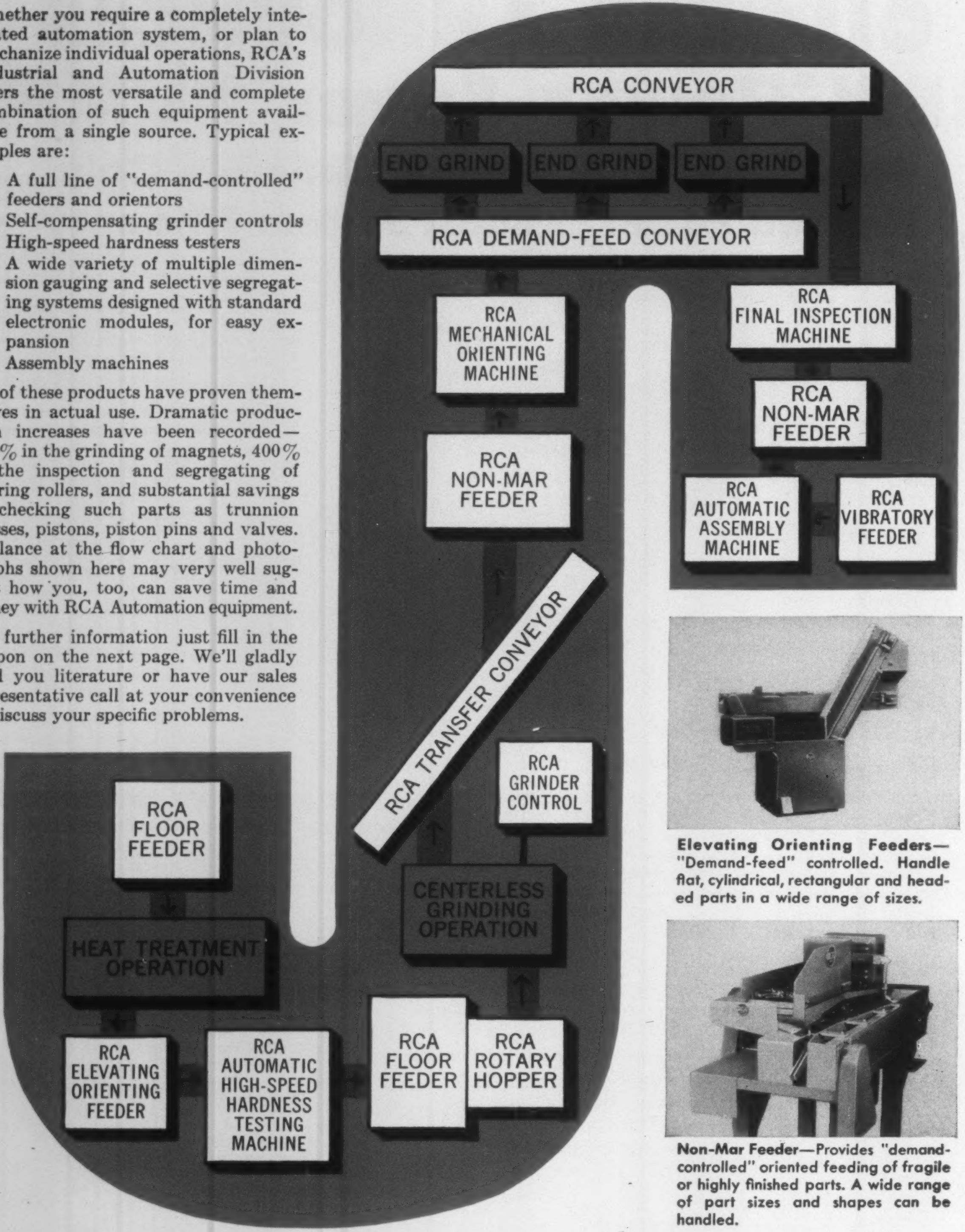
REDUCE COSTS . . . INCREASE PRODUCTION

Whether you require a completely integrated automation system, or plan to mechanize individual operations, RCA's Industrial and Automation Division offers the most versatile and complete combination of such equipment available from a single source. Typical examples are:

- A full line of "demand-controlled" feeders and orientors
- Self-compensating grinder controls
- High-speed hardness testers
- A wide variety of multiple dimension gauging and selective segregating systems designed with standard electronic modules, for easy expansion
- Assembly machines

All of these products have proven themselves in actual use. Dramatic production increases have been recorded—200% in the grinding of magnets, 400% in the inspection and segregating of bearing rollers, and substantial savings in checking such parts as trunnion crosses, pistons, piston pins and valves. A glance at the flow chart and photographs shown here may very well suggest how you, too, can save time and money with RCA Automation equipment.

For further information just fill in the coupon on the next page. We'll gladly send you literature or have our sales representative call at your convenience to discuss your specific problems.

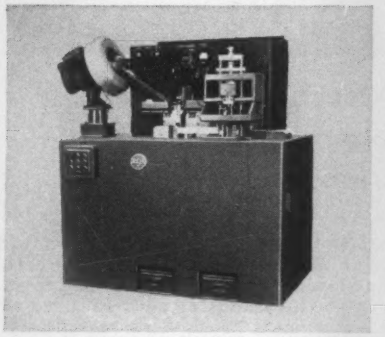

RCA CONVEYOR
END GRIND
END GRIND
END GRIND
RCA DEMAND-FEED CONVEYOR
RCA MECHANICAL ORIENTING MACHINE
RCA NON-MAR FEEDER
RCA FINAL INSPECTION MACHINE
RCA NON-MAR FEEDER
RCA AUTOMATIC ASSEMBLY MACHINE
RCA VIBRATORY FEEDER
RCA TRANSFER CONVEYOR
RCA GRINDER CONTROL
CENTERLESS GRINDING OPERATION
RCA FLOOR FEEDER
HEAT TREATMENT OPERATION
RCA ELEVATING ORIENTING FEEDER
RCA AUTOMATIC HIGH-SPEED HARDNESS TESTING MACHINE
RCA FLOOR FEEDER
RCA ROTARY HOPPER

Elevating Orienting Feeders—"Demand-feed" controlled. Handle flat, cylindrical, rectangular and headed parts in a wide range of sizes.

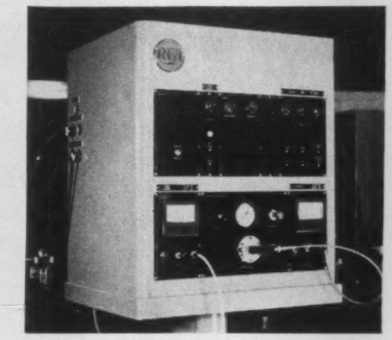
Non-Mar Feeder—Provides "demand-controlled" oriented feeding of fragile or highly finished parts. A wide range of part sizes and shapes can be handled.

BACKED BY YEARS OF EXPERIENCE IN

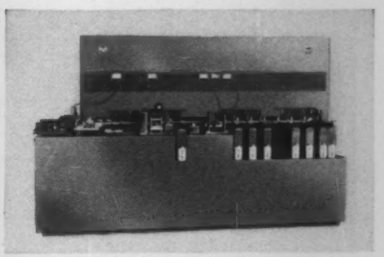
WITH RCA "BUILDING-BLOCK" AUTOMATION



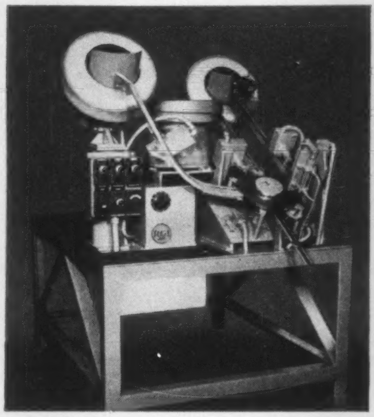
Automatic High-Speed Hardness Testing Machines—Inspect up to 2500 parts per hour with laboratory accuracy.



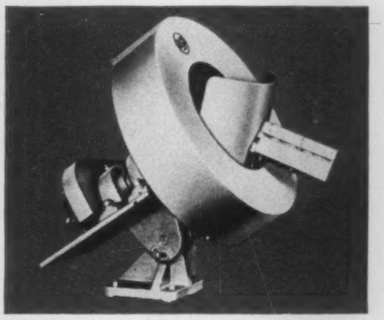
Centerless Grinder Control—Accurate to .000050", RCA self-compensating grinder controls can be used in rough as well as finish operations. Extreme reliability and 100% repeatability are reported by users.



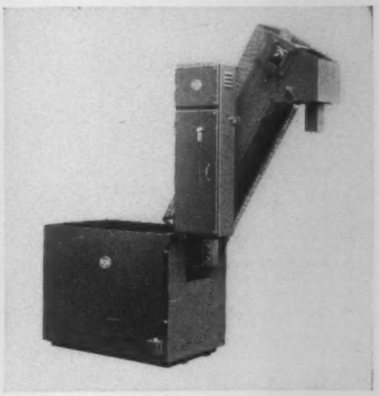
Final Inspection Machines—Equipment similar to the one above, inspect O.D., I.D., length, taper, true roundness. They also provide automatic segregation of inspected parts into almost any desired number of categories, as well as stamping and counting.



Automatic Assembly Machines—This unit automatically assembles bolts and lock washers. It is one of the many assembly machines developed by RCA.



Rotary Hopper—Exceptionally low in cost, RCA rotary hoppers are available with 18", 24", and 30" bowls. RCA orienting discharge tracks for various part sizes and shapes are mounted on the hopper by merely loosening and tightening one screw.



Floor Feeders—High-Speed, "demand-feed" control, broad versatility in parts handled, and large storage capacity make these units ideal for integrating machine operations.

Mail coupon below for further facts

Tmk(s) ®

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ELECTRONICS AND AUTOMATIC CONTROL

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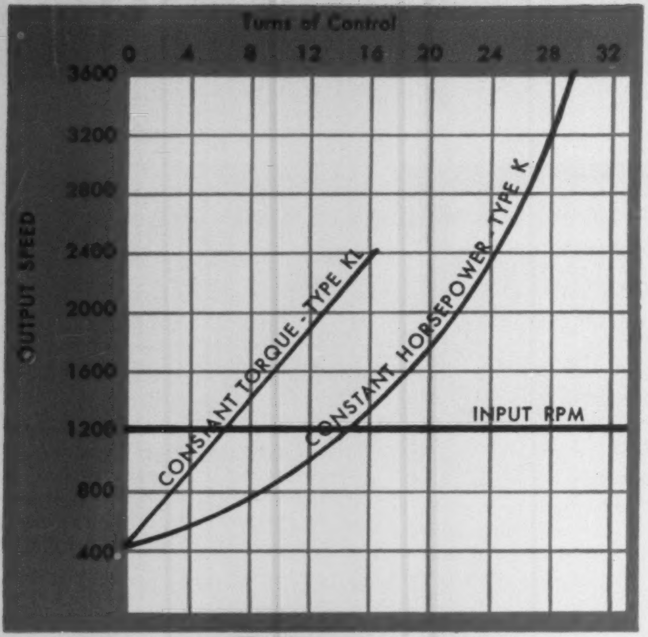


Typical speed regulation curves for the Types K and KL Variators. Type KL offers a linear speed regulating pattern, often an advantage in automatic control applications. Output speed regulation of the Type K Variator follows a geometric progression pattern. Starting at the minimum output speed, each turn of the speed regulating wheel produces a fixed percentage increase in output shaft speed.

CLEVELAND SPEED VARIATOR

Accurately Provides Dependable, Infinitely Variable Speed Control

ANNOUNCED late in 1954, the new Cleveland Speed Variator met instant, enthusiastic acceptance. Engineers and designers of industrial equipment already have put thousands of units into use on such varied equipment as cigarette making machines, textile machinery, metalworking machinery, pharmaceutical equipment, transfer tables, conveyors and experimental and testing equipment of many types.

Infinitely variable, the Cleveland Speed Variator gives stepless speed over a full 9:1 range—from ⅓ to 3 times input speed. Output speed can be adjusted by either a hand wheel on the Variator or by manual or automatic remote control.

The Cleveland Speed Variator offers these major advantages:

1. An extremely compact unit with input and output shafts in line and rotating in the same direction.

2. Almost any input speed up to 1800 RPM can be used—either clockwise or counterclockwise rotation.

3. Rated for constant horsepower output over a 9:1 or 6:1 range; or for constant output torque over a 6:1 range.

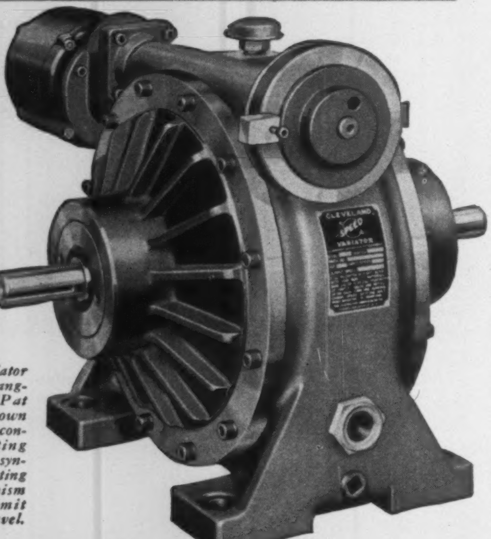
4. Speeds infinitely variable over entire range of adjustment.

5. No slippage—positive torque response mechanism adjusts in direct proportion to the loads encountered.

6. Long life and minimum maintenance due to absence of belts or complicated linkages.

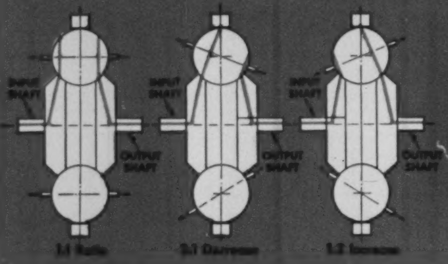
7. Ample bearing support for overhung pulleys on both input and output shafts.

Write for Bulletin K-200 for detailed description with photographs, sectional drawings, rating tables and specifications.



The Cleveland Speed Variator is available in 18 models ranging from fractional to 16 HP at 1750 input RPM. Unit shown at right, used in process control, has speed regulating worm driven by 75 RPM synchronous motor, with adjusting shaft indicating mechanism modified to actuate limit switches to prevent overtravel.

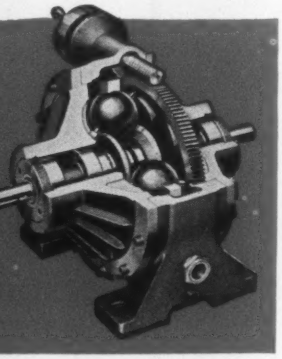
HOW THE CLEVELAND SPEED VARIATOR WORKS



Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts.

Relative speeds of the shafts are adjusted by changing the positioning of axles on which the balls rotate (diagram, right, shows cutaway Variator with hand regulating wheel).

"It's the Drive That's on the Ball."



THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3265 East 80th Street, Cleveland 4, Ohio
Subsidiary of Eaton Manufacturing Company

AUTOMATION news

Today's events and developments in the field of automation

Freight Car Tracing System Provides Nationwide Control

TASK of identifying, controlling, and tracing freight cars represents a major operating expense to the railroad industry. In order to reduce this expense, Link Aviation Inc. has developed a new identification and control system, called Tracer, which can automatically provide continuous, up-to-date information on the location of all freight cars in a railroad system.

The new system consists of two major components. One is a small response block which would be attached to the underside of each freight car to provide an electronic signal identifying each car. The other component is a magnetic interrogator coil which would pick up the electronic identifying signal and relay it through an interrogator unit to a control center.

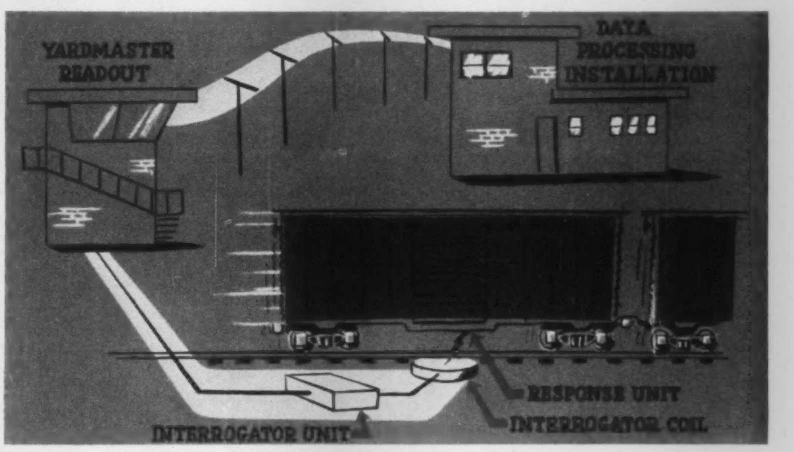
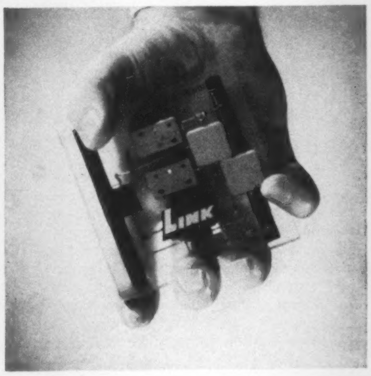


DIAGRAM illustrates how the Tracer system developed by Link Aviation Inc. would be used to identify rolling stock on a railroad system. As the freight car passes over the interrogator coil at speeds up to 100 miles per hour, the response block or unit attached to the underside of the car would transmit a signal specifically assigned to the particular car. This identification signal would then be relayed to a central data processing installation for correlation with other data such as car destination, consignee, and routing.

The response blocks contain no batteries and require no external power. They measure approximately 4 by 4 by 1 inch and weigh less than one pound. It is possible to manufacture as many as several million different blocks, each of which would transmit a different electronic signal when passing over an interrogator. Therefore, every freight car in the country could be equipped with its own individual signal which could instantly identify the car whenever it passed over detection units.



RESPONSE block used with the tracer system measures approximately 4 by 4 by 1 inch and requires no external power source. As many as several million different blocks can be manufactured, each of which would transmit a different electronic signal.

The interrogators, which would be located at strategic points along a railroad system, would transmit the identification of each passing car to a central data processing facility, using telephone, wires, or radio as a means of transmittal. Other inputs into the central facility, such as car destination, consignee, routing, and classification, would be stored in a memory system. With this stored information, plus the car identification provided by the interrogator, efficient control of rolling stock would be possible with increased accuracy and minimum expense. The signal might also be transmitted to a yardmaster station, where it could be used for local control of rolling stock when making up trains.

In addition to railroad use, the system could also be employed in on-the-ground terminal control of aircraft, enroute control and spacing of city transit vehicles, and in other applications where identification and control of moving objects is desired in order to eliminate congestion and increase operating efficiency. The system can operate in virtually any environment of weather and temperature and is capable of identifying cars passing at speeds up to 100 miles per hour. Tracer will be manufactured by Link Aviation and distributed by Western Railroad Supply Co.

Automatic Facility Eliminates Brazing-Soldering Bottleneck

AUTOMATIC brazing and soldering facility developed by Raytheon Mfg. Co. has made possible a reduction in brazing and soldering time of 90 per cent in the production of subminiature gyroscope and accelerometer parts for Sparrow III missiles. Formerly requiring three minutes, the operation can now be accomplished in 18 seconds.

The facility is designed to handle silver brazing, lead-tin alloy soldering, shrink fitting, hardening, tempering, and local stress removal in a controlled atmosphere. Brazing can be accomplished in a hydrogen atmosphere with a nitrogen purge after each operation. Production tolerances can be held and temperatures closely controlled between the limits of 90 and 3000 F.

The high frequency heater associated with the facility is unique in that it has a variable impedance output which can be matched to the load, rather than requiring the load to be matched to a fixed heater impedance. Designed and built by the Industrial Heating Dept., General Electric Co., the variable impedance heater has several practical advantages. In designing the induction heating coils used in the fixture, each coil can be designed for optimum heat pattern, and the impedance of the induction heater can be quickly matched to the load by a dial control. This feature saves design time, permits the use of interchangeable fixture components, and provides maximum system flexibility.

The brazing and soldering operations are done within the confines of either of two bell jars mounted at table-top level. With the bell jar in a raised position, the operator places a part into a fixture, and then simultaneously presses two starting buttons. The bell jar lowers to envelop the work area, and all steps in the process including atmosphere admission, heating, purging, and raising of the bell jar are automatically controlled at preset intervals by a timer. According to **L. C. Porter**, Raytheon applications engineer, the rejection problem commonly encountered in this type of operation has been practically eliminated. The installation has also eliminated a serious production bottleneck by cutting out wasted time and inaccuracies.

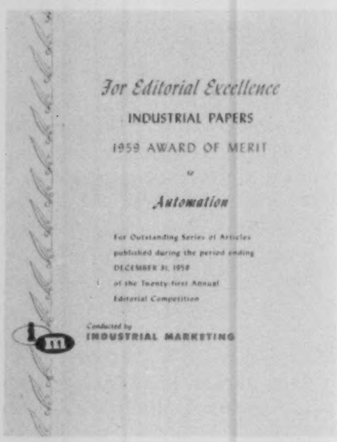
ELECTROSTATIC chuck which will hold both magnetic and nonmagnetic metal workpieces, ceramics, and plastics has been developed by Electroforce Inc. The unit employs electrostatic rather than electromagnetic forces to hold work with positive rigidity. This is done by imposing a static electric charge on the surface of the workpieces which are electrically isolated from the face of the chuck by a thin film of special dielectric fluid. Nonmetallic materials can be used in the chuck if their chucking surfaces are flashed with a metallic coating as thin as 0.000005 inch.

Color Matching System Eliminates Human Errors

ELECTRONIC system which can detect color variations unnoticable to the human eye is being used to produce styrene molding compounds to match customer's samples at the Plastics Div., Monsanto Chemical Co. In addition to being much more sensitive and precise than conventional visual methods, the system eliminates errors in color matching due to differences in lighting conditions which distract and confuse the human eye.

The system combines a spectrophotometer with a specially designed computer. The computer allows the use of a complex formula for measuring minute color differences that long has been recognized as more accurate than conventional visual techniques. Previously, the formula has not been used for routine color inspection because it has been impractical to perform the necessary calculations manually.

By using the new system, Mon-



For Editorial Excellence

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to

Automation

For Outstanding Series of Articles
published during the period ending
DECEMBER 31, 1958
of the Twenty-first Annual
Editorial Competition

Conducted by
INDUSTRIAL MARKETING

AUTOMATION Cited For Editorial Excellence

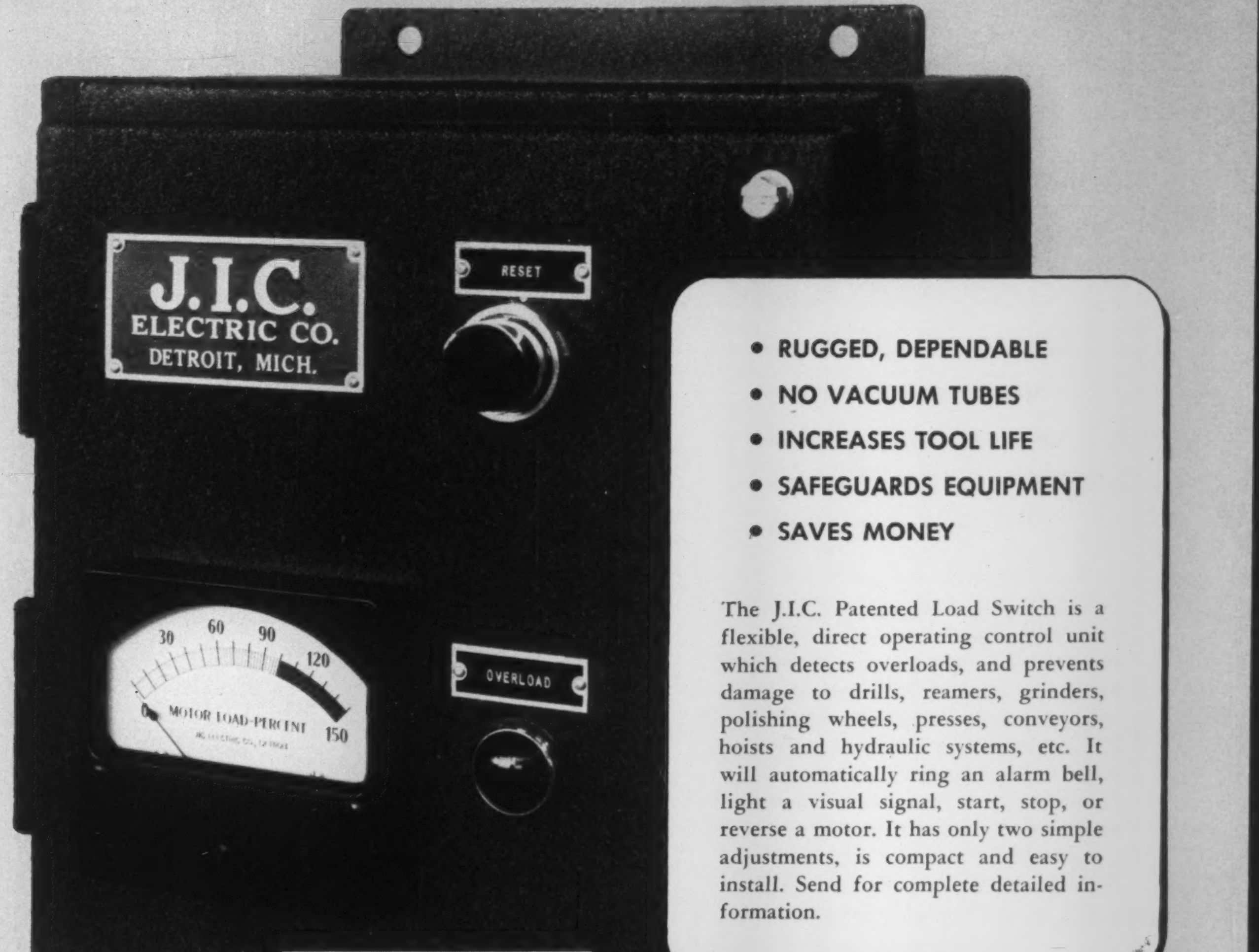
FOR THE SECOND straight year AUTOMATION has been cited for high editorial excellence in the recent 21st Annual Business Paper Editorial Achievement Competition sponsored by *Industrial Marketing*.

Certificate of Merit was awarded to AUTOMATION for an "outstanding series of articles on one theme in an industrial classification" for its entry written by R. Hadekel entitled "Hydraulic Control of Automatic Machinery." This 7-article series was published in the August, October, and December 1957 issues, and the February, April, June, and August 1958 issues. Covered in the 48-page series were major aspects of the synthesis of hydraulic systems from commercially available components. Special emphasis was placed on the selection and evaluation of hydraulic pumps and actuators, automatic acting and external control valves, servo valves and auxiliary hydraulic equipment, automatic sequencing circuits, hydraulic systems engineering, and hydraulic and electrohydraulic servo systems. To fill numerous requests for the complete series, the articles were reprinted in booklet form.

Other business magazines published by Penton Publishing Co. also received recognition in the 21st annual editorial competition. Out of a possible 19 awards in the industrial publications grouping, Penton entries from AUTOMATION, STEEL, and MACHINE DESIGN won one plaque and five certificates. Since 1938, Penton publications have been awarded 14 plaques, 43 certificates, and 2 special awards.

J·I·C Load Switch

Automatic Cost-Saving Trouble Detector



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- NO VACUUM TUBES
- INCREASES TOOL LIFE
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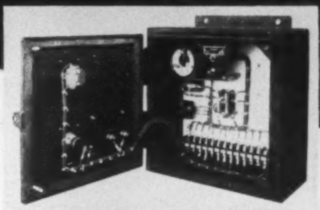
- SAVES MONEY

The J.I.C. Patented Load Switch is a flexible, direct operating control unit which detects overloads, and prevents damage to drills, reamers, grinders, polishing wheels, presses, conveyors, hoists and hydraulic systems, etc. It will automatically ring an alarm bell, light a visual signal, start, stop, or reverse a motor. It has only two simple adjustments, is compact and easy to install. Send for complete detailed information.



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1. Single Load Switch
2. Single Load Switch with Timer
3. Double Load Switch
4. Double Load Switch with Timer

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Our panel men and engineers specialize in designing and building all types of Electrical Control Systems. They will lay out a system to your standards.

A QUOTATION FROM J.I.C. TODAY CAN SAVE YOU TIME AND MONEY

Circle 658 on Page 17

J·I·C ELECTRIC COMPANY
19255 W. Davison Detroit 23, Mich.

Please send the Bulletins checked below:

☐ Load Switch Bulletin
☐ Special Purpose Electric Controls
☐ Electrical Control Centers

NAME ______________________
COMPANY ______________________
ADDRESS ______________________
CITY ______________ ZONE ________ STATE ________

santo is now in a position to supply production quantities of colored products to match a customer's sample without going through the necessity of customer verification and approval of trial matches. It is now possible to select styrene plastics colors by specifying the desired chromatic dimensions in a similar manner as industry now specifies size, weight, or specific gravity for purchased materials.

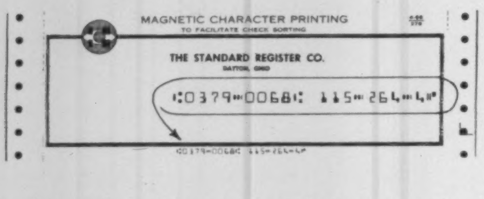
Contract Awarded For Photochromic Memory Study

MILITARY contract of $90,000 has been awarded to the Electronics Div., National Cash Register Co., by the Wright Air Development Center Aeronautical Research Laboratory for theoretical and experimental investigation of photochromic memory techniques and devices.

Studies will be based on an encapsulation technique created by NCR research laboratories in which a light-sensitive liquid dye is stored in a gelatin capsule only 0.0000025 meter in diameter. Because the fluid has the necessary two stable states for switching, the microscopic chemical memory cell

Magnetic Ink—Key To Bank Automation

MAGNETIC ink characters, approved as standard by the American Bankers Association, enable banks to sort and post checks automatically on electronic equipment. Checks are first preprinted before issue with routing, transit, and account numbers in magnetic ink such as shown in the following sample furnished by the Standard Register Co.

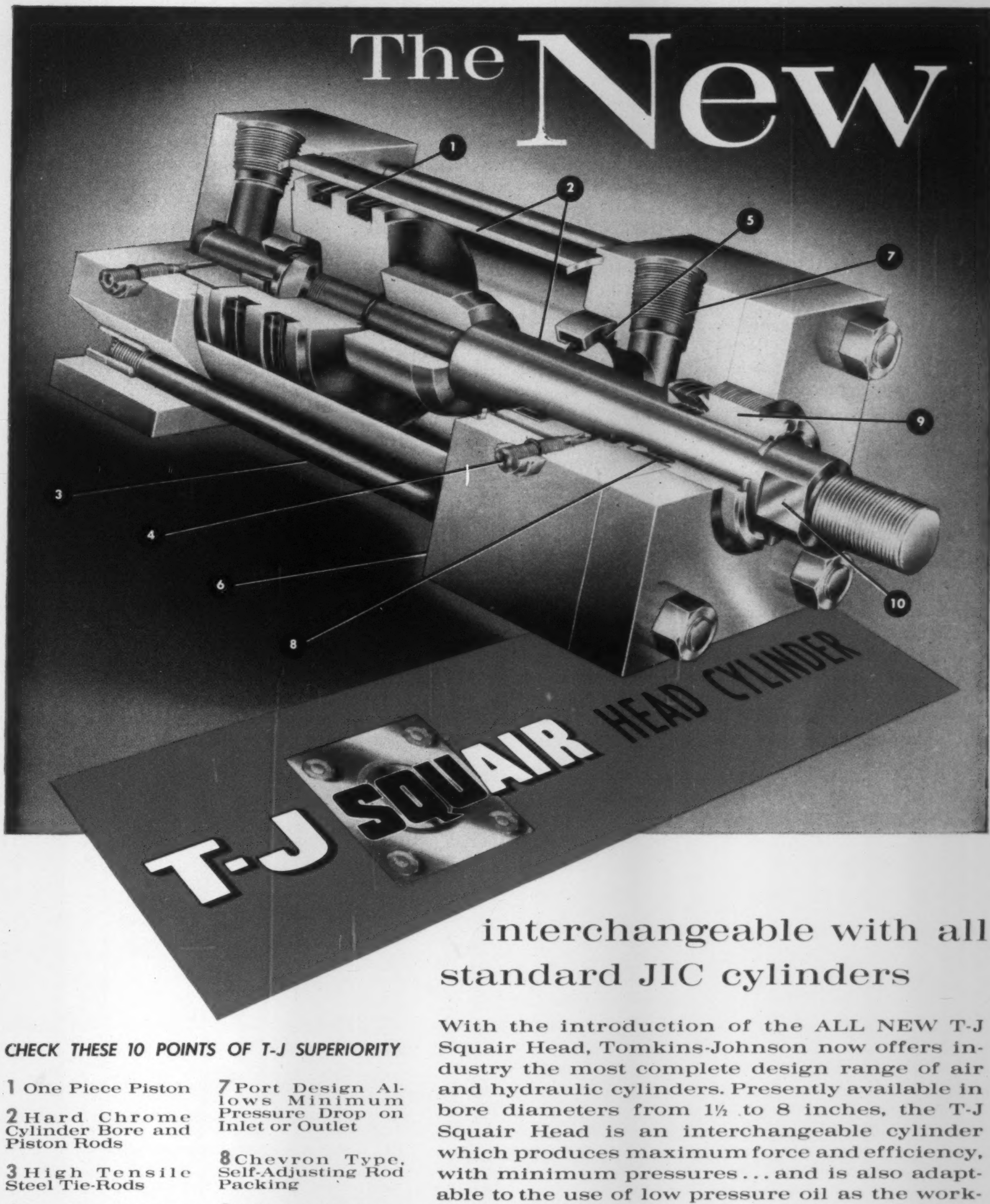

MAGNETIC CHARACTER PRINTING
TO FACILITATE CHECK SORTING
THE STANDARD REGISTER CO.
DAYTON, OHIO
⑆0379⑉0068⑆ 115⑉264⑉4⑈

The digits and symbols printed at the bottom of the check are designed with a unique shape so that they can be read both visually and electronically. When the ink is magnetized, and read by equipment, each character provides a specific impulse that is not duplicated by any other digit or symbol. After the check is used and arrives at a bank for payment, a transaction number and the dollar amount of the check is printed in magnetic ink to the right of the preprinted information. Stacks of checks are then placed in electronic equipment which reads all the magnetic character information and sorts the checks into various classifications. Accompanying photographs show some of the latest developments in automatic bank sorting equipment.

ASSEMBLY line for automatic check sorting and reading machines is in operation at Pitney-Bowes Inc. The sorter-reader, developed in co-operation with National Cash Register Co., will save as much as 30 to 40 per cent of a bank bookkeeper's time in sorting and filing checks. As production grows, the machines will be used for other commercial organizations with paper-handling and accounting problems.

METROPOLITAN banks may process as many as 500,000 to a million checks per day. This Burroughs Corp. magnetic character sorter handles over 1500 checks per minute which is 10 times faster than manual sorting. Ray Eppert, president of Burroughs, estimates that 14,000 banks in this country now sort 12 billion checks per year, but in the next five years this total will rise to at least 22 billion yearly. Therefore, bank automation is a must if processing costs are to be held in line.

CHECKS, preprinted before issue with routing, transit, and account numbers, have dollar amount and control information imprinted on them in magnetic ink on this proof-inscriber manufactured by International Business Machines Corp. Simultaneously, the unit provides individual listings and totals on tape of all transactions, accumulated totals for proving balances, prints endorsements, and establishes control totals. Transistorized sorter-reader, left background, next sorts checks of varying sizes and reads magnetic data on them into an IBM data processing system through the control unit, right background.



interchangeable with all standard JIC cylinders

CHECK THESE 10 POINTS OF T-J SUPERIORITY

1 One Piece Piston

2 Hard Chrome Cylinder Bore and Piston Rods

3 High Tensile Steel Tie-Rods

4 Cushion Adjusting Screw, Externally Adjustable

5 New Super-Cushion for air, or Self-Aligning Master Seal for Oil (T-J Patents)

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7 Port Design Allows Minimum Pressure Drop on Inlet or Outlet

8 Chevron Type, Self-Adjusting Rod Packing

9 Piloted Packing Gland—Absolute Alignment

10 Piston Rod, Extra Strong—Polished and Chrome Plated for Efficiency and Protection

With the introduction of the ALL NEW T-J Squair Head, Tomkins-Johnson now offers industry the most complete design range of air and hydraulic cylinders. Presently available in bore diameters from 1½ to 8 inches, the T-J Squair Head is an interchangeable cylinder which produces maximum force and efficiency, with minimum pressures . . . and is also adaptable to the use of low pressure oil as the working medium. Write to The Tomkins-Johnson Co., Jackson, Michigan, for Bulletin #SQ 10-58 and complete details.

T-J
TOMKINS-JOHNSON
RIVITORS . . . AIR AND HYDRAULIC CYLINDERS . . . CUTTERS . . . CLINCHORS

Circle 659 on Page 17

can store or give up information instantaneously in response to a beam of light. It is possible to coat a square inch of film with one million of the capsules.

Eventual application of the research findings will be in automatic central control and data systems for high-altitude vehicles. The immediate goal is to obtain all necessary data for a detailed preliminary design of a feasibility model of an optimum photochromic memory. Development of encapsulation techniques and synthesis of chromatic dyes are being carried on under other NCR programs and are not a part of this contract.

Graphite Available In Flexible Textile Form

PROCESS to convert organic textile forms—yarns, braids, felts, and fabrics that are woven or knit—directly to graphite has been developed by National Carbon Co., Div., Union Carbide Corp. The resultant graphite textiles retain their flexibility and in most cases increase in tensile strength.

In the complex production process, for which patents have been applied, a fiber or fabric is graphitized by electrically heating it to a temperature approaching 5400 F. In a thermochemical conversion, the crystalline structure of the material is changed to that of graphite similar to manufactured graphite used for electric furnace electrodes, metallurgical molds, and other industrial purposes.

The graphite textiles are resistant to attack by acids, alkalies, and organic compounds, except for those of a highly oxidizing nature, and do not react with many molten metals. They have excellent electrical and thermal conductivity and are immune to thermal shock.

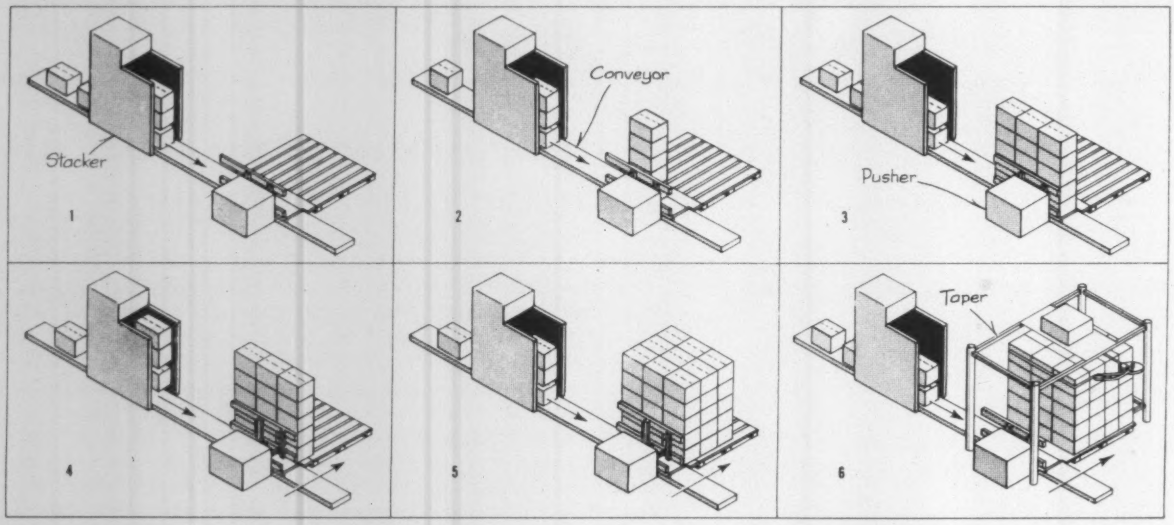
Possible uses for the new materials are limitless. They can be used to impart electrical and thermal conductivity to nonconducting materials such as plastics, ceramics, and glass cloth. Graphite cloth of the proper mesh is being considered for bag type filters for hot nonoxidizing gases. Its possible electrical uses include resistance heating elements using its flexible nature to put the heat exactly where it is wanted. Other applications include its use as valve packing and gasket materials for high temperature seals. Conveyor belting for high temperature process equipment is another possibility.

Experimental quantities of graphite fibers and fabrics are being made for industrial test and evaluation. For example, a square weave cloth, 28 by 28 thread construction, is being made in a 40-inch width in lengths up to 7 feet and an average thickness of 0.024 inch. Initial price for experimental quantities of this weave is $1.50 per square foot.

Lubricant Relatively Unaffected By Heat, Acid, and Pressure

NEW LINE of lubricants providing improved heat, acid, and pressure resistant qualities is being marketed by Lubrication Engineers Inc. Called Almasol, the lubricant is a soft, tan powder which is compatible with all forms of petroleum and can be processed into workable solutions.

Almasol products form micro-thin layers of natural lubricant between the fluid-film of oil and a metal surface. The first layer bonds itself to the metal surface, and the material's molecular structure causes other layers to slide horizontally across the bonded layer. As stated



AUTOMATIC pallet-loader developed by Lathrop Paulson Co. requires no pit and can be placed on top of the floor. The equipment operates at speeds up to 15 cartons per minute and consists of three synchronized, separately powered units—a stacker, a pusher, and a taper. Operation of the system is as follows: 1. Single cartons enter stacker and are lifted to form first stack. 2. First stack is lowered to conveyor and moves to a stop at right of pusher while second stack is being formed. 3. Three stacks of cartons are accumulated at pusher, ready for transfer from conveyor to pallet. First stack of second row is assembled in stacker. 4. Pusher transfers first row of cartons to pallet. 5. Second and third rows of cartons are accumulated and transferred to pallet. As each row is transferred, it pushes the preceding rows toward the far edge of the pallet. 6. After a full pallet load has been assembled, the automatic taper applies a strip of pressure sensitive tape to top layer of cartons to create load stability. (For clarity, taper is not shown in other views.) Pallet is then ready to be moved to storage by fork truck. Optional equipment such as an automatic pallet dispenser and an accumulator roller conveyor line for loaded pallets can be incorporated in the operation.

NATIONAL ELECTRIC

solves tough production problem of welding air-suspension brackets for 1958 cars

The new air suspension systems introduced on some 1958 cars, create not only a super-smooth ride for passengers . . . but many production problems for manufacturers. To help lick one of these problems . . . National Electric designed and built two new multi-station arc welders that perform 2 important operations on the structural members of the new systems.

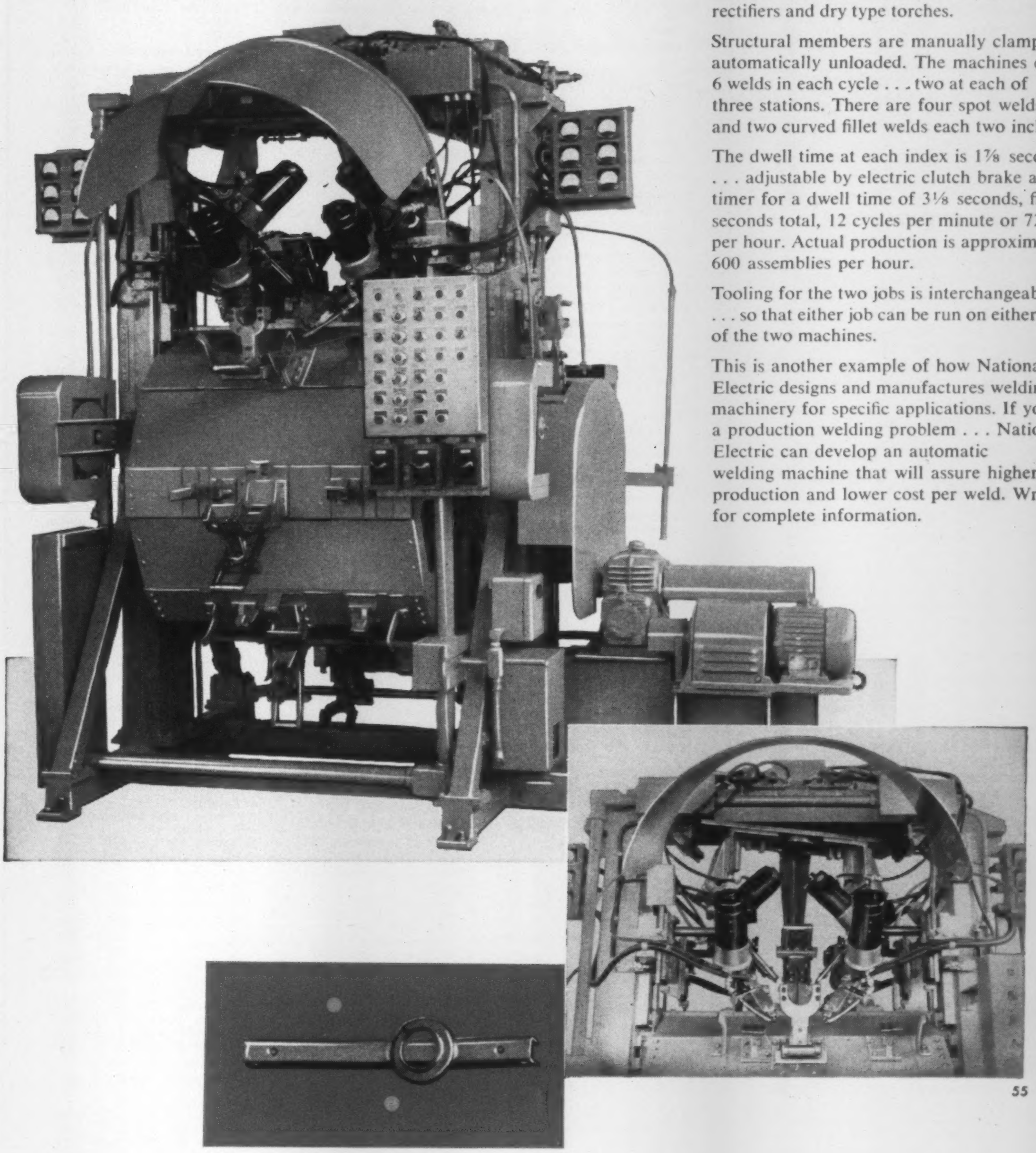
These 6-head, CO_2 arc welders incorporate a drum feed, 8-station Geneva Index, with 800 amp. rectifiers and dry type torches.

Structural members are manually clamped and automatically unloaded. The machines complete 6 welds in each cycle . . . two at each of three stations. There are four spot welds . . . and two curved fillet welds each two inches long.

The dwell time at each index is 1⅞ seconds . . . adjustable by electric clutch brake and timer for a dwell time of 3⅛ seconds, five seconds total, 12 cycles per minute or 720 cycles per hour. Actual production is approximately 600 assemblies per hour.

Tooling for the two jobs is interchangeable . . . so that either job can be run on either of the two machines.

This is another example of how National Electric designs and manufactures welding machinery for specific applications. If you have a production welding problem . . . National Electric can develop an automatic welding machine that will assure higher production and lower cost per weld. Write for complete information.



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Hoffman

JIC and NEMA 12

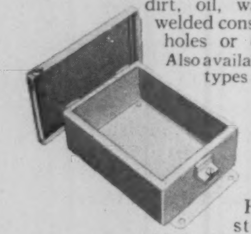
OIL-TIGHT
DUST-TIGHT
ELECTRICAL ENCLOSURES

WALL MOUNTED, in 18 stock sizes.

FLOOR MOUNTED, in double door or multiple door units—11 stock sizes.

JIC NEMA 12 PANEL ENCLOSURES

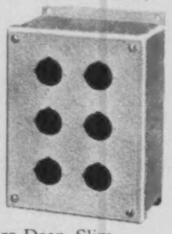
Ideal for housing electrical controls, components and terminal strips. Note removable mounting panel. Neoprene gasket on door protects against dust, dirt, oil, water. Strong welded construction. No holes or open seams. Also available in NEMA types 1, 3, 4 and 5.



JIC WIRING BOX

Heavy gauge steel, welded seams. No knockouts or holes to leak oil, water or dust. Neoprene gasketed cover with screw clamp makes tight oil-proof seal. Available with or without removable panel. 8 stock sizes from 4"x4"x3" to 16"x14"x6".

PUSHBUTTON ENCLOSURES



A complete selection of types and sizes. Fine quality construction and finish. Welded seams. Cover has neoprene gasket. Holes take any standard oil-tight pushbutton. Types range from "Standard" *as shown*, to Extra Deep, Slim and Pendent. For one to 25 pushbuttons.

OIL-TIGHT JIC SECTIONAL WIREWAY

Perfect protection for control wiring. Neoprene gasket on cover and between joints seals out liquids and dust. Easy to assemble. Full length hinged cover simplifies wiring installation or modification after installation. Stock sizes: 2½"x 2½", 4"x 4" and 6"x 6" in lengths up to 10' with Elbows, "T"s, etc.

We also build enclosures to customer specifications

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NEW EQUIPMENT • NEW COMPONENTS • CATALOGS & LITERATURE • ADVERTISED PRODUCTS OR SERVICES

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AUTOMATION

Information Service

For your convenience, advertisements and items of information on new equipment, components and manufacturers' literature can be quickly identified by an *Item Number* accompanying each unit.

For additional free information circle item number on an inquiry card. Fill in your name, title, address, etc.—Drop it in the mail—Your request will receive prompt attention and will be filled directly by the manufacturer.

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404	444	484	524	564	604	644	684	724	764	804
405	445	485	525	565	605	645	685	725	765	805
406	446	486	526	566	606	646	686	726	766	806
407	447	487	527	567	607	647	687	727	767	807
408	448	488	528	568	608	648	688	728	768	808
409	449	489	529	569	609	649	689	729	769	809
410	450	490	530	570	610	650	690	730	770	810
411	451	491	531	571	611	651	691	731	771	811
412	452	492	532	572	612	652	692	732	772	812
413	453	493	533	573	613	653	693	733	773	813
414	454	494	534	574	614	654	694	734	774	814
415	455	495	535	575	615	655	695	735	775	815
416	456	496	536	576	616	656	696	736	776	816
417	457	497	537	577	617	657	697	737	777	817
418	458	498	538	578	618	658	698	738	778	818
419	459	499	539	579	619	659	699	739	779	819
420	460	500	540	580	620	660	700	740	780	820
421	461	501	541	581	621	661	701	741	781	821
422	462	502	542	582	622	662	702	742	782	822
423	463	503	543	583	623	663	703	743	783	823
424	464	504	544	584	624	664	704	744	784	824
425	465	505	545	585	625	665	705	745	785	825
426	466	506	546	586	626	666	706	746	786	826
427	467	507	547	587	627	667	707	747	787	827
428	468	508	548	588	628	668	708	748	788	828
429	469	509	549	589	629	669	709	749	789	829
430	470	510	550	590	630	670	710	750	790	830
431	471	511	551	591	631	671	711	751	791	831
432	472	512	552	592	632	672	712	752	792	832
433	473	513	553	593	633	673	713	753	793	833
434	474	514	554	594	634	674	714	754	794	834
435	475	515	555	595	635	675	715	755	795	835
436	476	516	556	596	636	676	716	756	796	836
437	477	517	557	597	637	677	717	757	797	837
438	478	518	558	598	638	678	718	758	798	838
439	479	519	559	599	639	679	719	759	799	839
440	480	520	560	600	640	680	720	760	800	840

AUTOMATION **June, 1959**

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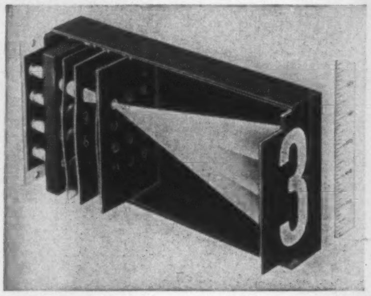
in a patent application, the shield provided by the material is so permanent that it can only be ground away.

The new lubricant is impervious to acid, and the layer bonded to the metal surface serves as a permanent shield against damage from acid corrosion. It can withstand greater pressures than graphite, and its lubrication qualities remain unchanged at temperatures up to 1900 F. Price of Almasol lubricants ranges from about $0.60 per pound for most applications up to $7.40 per pound for special formulas for jet aircraft use.

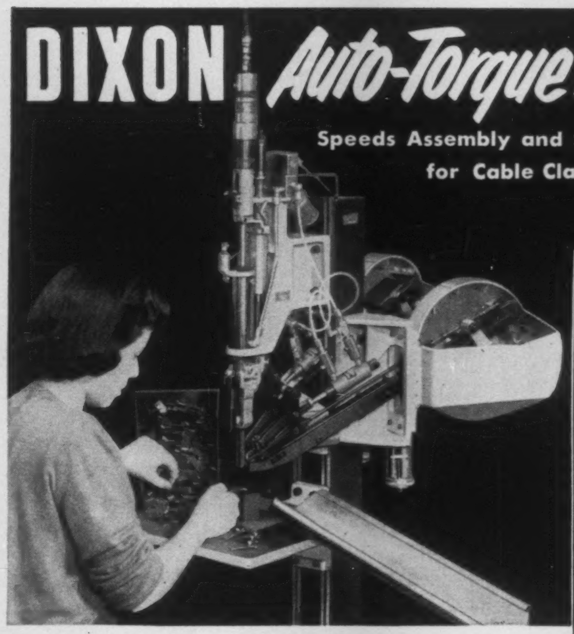


DIGITAL display unit manufactured by Industrial Electronics Engineers Inc. uses a rear projection-type readout to display digits or characters which are 3¾ inches high by 2 inches wide. Each digit or character displayed has its own optical system consisting of two condensing lenses and one projection lens. The body case is made of aluminum, and the over-all size is 11½ inches long by 3¼ inches wide by 5¼ inches high. Displayed data can be viewed from a distance of over 100 feet.

Transparent Potting Compound Permits Instrument Checking

SILICONE potting material that permits visual and instrument checking of individual parts within a potted assembly has been developed by Dow Corning Corp. Designated as Dow Corning Dielectric Gel, the clear liquid is easily applied and readily surrounds components. It cures in place to form a resilient mass that combines dielectric properties with thermal stability and moisture resistance.

Since the cured material is transparent, potted circuits can be traced visually. If circuit testing is necessary, test probes can be directed to connections by inserting the probes through the gel. When the test



DIXON *Auto-Torque Driver*

Speeds Assembly and Screw Driving for Cable Clamp

2000 Hand-Fed Assemblies Per Hour—Two Parts Placed With A Single Chuck

The machine shown above, which is tooled for the assembly and screw-driving work for a three-part cable clamp, is a good example of the adaptability and versatility of the DIXON *Auto-Torque* Driver (Automatic Screw Driver). Two feeders place the Phillips Head Screw and one part of the clamp in a *single* chuck with positive action. The self-tapping screw is then driven to a predetermined depth into the base part, which has been placed in the fixture by the operator.

Exclusive Design Features Provide Accurate, Dependable Operation

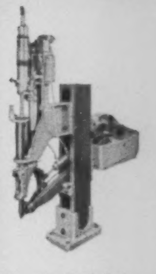
Many design features contribute to the over-all efficiency and dependable operation of the DIXON *Auto-Torque* Driver, which is furnished in standard models or as special arrangements. Chief among these is the positive-acting feeder with ram-action placement of the part into the chuck. This feeder is compact, with a straight track and an orienting block to avoid jams, assuring proper entry of the screw or nut into the feed track.

A built-in sensing mechanism operates automatically to stop the machine when a screw is missing or only partially driven. This assures quality control and is essential for automatic installations. The sensing feature is also of great value when driving a screw or nut to a predetermined depth without torque requirement.

Another important feature is the *Adjustable-Torque* Clutch which can be furnished in two torque ranges. It represents a new high in accuracy, ease of adjustment, and smooth operation. Accuracy is within 5% of the torque setting and it can be furnished for closer tolerances for special applications. It cannot overdrive the screws.

Ask for Descriptive Matter or Special Information

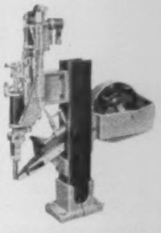
Complete information on the standard DIXON *Auto-Torque* Driver is given in Bulletin SD-B1. This and bulletins on other units are available on request. Tell us your requirements.



The standard *Auto-Torque* Driver as furnished for use as a fully automatic station. Also built as a pedestal model with foot treadle for starting the cycle.

●

OTHER DIXON EQUIPMENT



***Auto-Positioner* for small parts assembly. Furnished as automatic station or as pedestal model.**

Positive-Acting Piece Parts Feeder for delivering small parts to assembly machines, presses, etc.

Parts Escapement for releasing parts singly or in multiples.

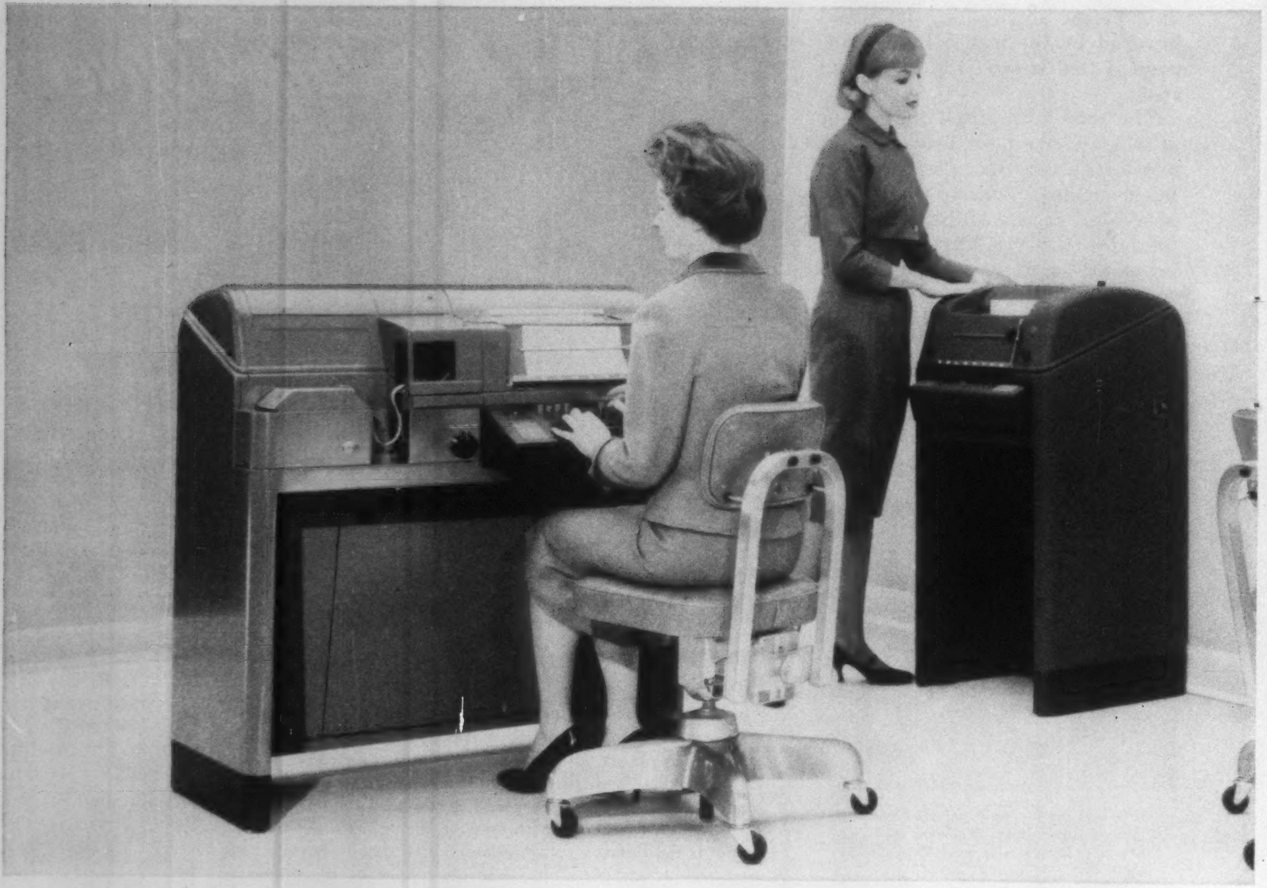
DIXON

DIXON AUTOMATIC TOOL, INC.

2312 - 23RD AVENUE ● ROCKFORD, ILLINOIS

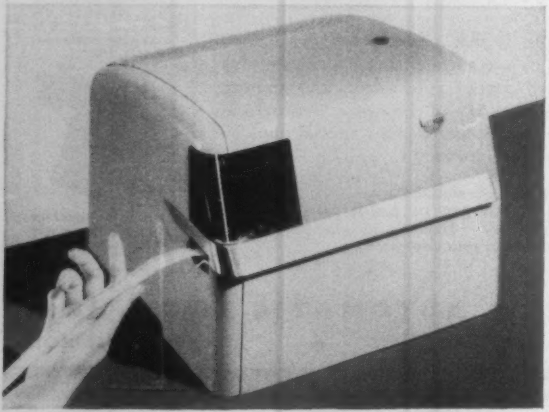
EQUIPMENT FOR AUTOMATIC PARTS HANDLING AND ASSEMBLY

Circle 662 on Page 17



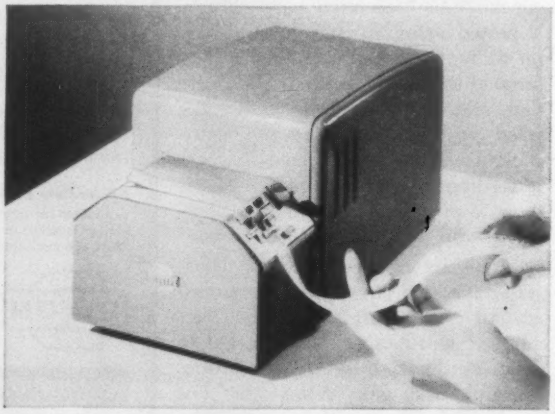
Teletype Model 28 Automatic Send-Receive Set A "complete station" in one console—with facilities for sending and receiving on message paper or sprocket-fed business forms . . . tape punching . . . sending or receiving with tape . . . integrating tape and manual keyboarding . . . producing tape automatically, as a by-product of send-receive operations.

Teletype Model 28 Tape Punch Receives incoming electrical signals, punches a 5-level "common language" tape, and prints data right on the tape, for easy identification and handling. Unit is used for message relaying . . . for integrating data from several sources into a single tape . . . for providing punched tape as a by-product of send-receive operations.



Teletype Model 28 Receive-Only Page Printer A message receiving unit (without keyboard). This is "terminal" equipment, for use where two-way communication is not necessary. No attendant is needed. Produces a printed record on plain paper or multi-part business forms. Table models of this unit and the send-receive set at the right are also available.

Teletype Model 28 Tape Reader This is a sending unit. Reads punched tape and instantaneously transmits data to local or remote receiving equipment. As with all Teletype transmitting units, data may go to one destination or a number of destinations simultaneously—either nearby or thousands of miles away.



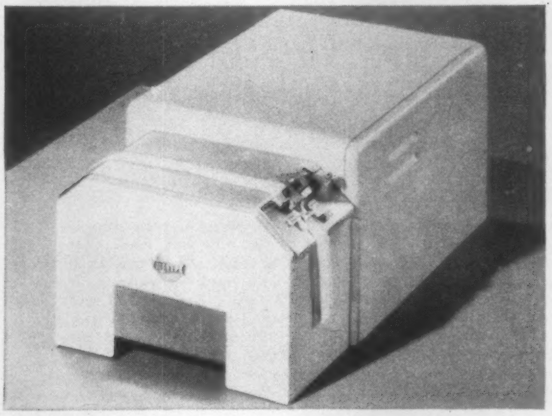
Applications unlimited . . .

TELETYPE Model 28 Line

For communications systems—on-premise or nationwide . . . data handling . . . mechanization . . . automation . . . telemetering.

Teletype Model 28 Send-Receive Page Printer Message originating unit, for sending and receiving. Model 28 page units, including the Automatic Send-Receive Set, feature a built-in "stunt box" control system for automatic station selection and electrical control of remote equipment. Horizontal tabulation and form positioning arrangement available.

Teletype Model 28 Tape Reader—Twin-Shaft Unit is similar to tape reader at left. Besides reading punched tape for on-line transmission, twin-shaft reader-distributor design offers facilities for tape transmission to business machines and direct read-out, from business machines, for on-line transmission.



Presented here are the principal units of the Teletype Model 28 Line. "Model 28" stands for an entirely new concept in record communications. It is an integrated line, designed on the modular principle, permitting a wide choice and ready interchange of components and providing accommodations for expansion. Typebox printing on page units makes possible quick interchange of alpha-numeric characters. Speed is 600 characters per minute with printing, up to 1,200 characters per minute on tape units where printing is not required.

These new machines are manufactured to Teletype's precision standards for continuous day-in and day-out service. Operation is not affected by tilt or vibration. All-steel clutches and simple harmonic design elements reduce and simplify maintenance; oiling is needed only once or twice a year.

Exclusive with the 28 Printer Line is the versatile Stunt Box, which is actually a "robot brain." It responds to keyboard or line signals, and may be used for internal control of extra functions in the Teletype printer and for remote control of Teletype or other electronic or electro-mechanical equipment.

The Teletype Model 28 Line opens new areas of applications in data communications. In addition to the self-contained units shown here, components are available to system manufacturers for integration with their equipment. The tested dependability, accuracy and adaptability of Teletype equipment make it ideally suited for system applications.

More information. If you would like more information on Model 28 equipment or components, please write to: Teletype Corporation, Dept. 21F, 4100 Fullerton Ave., Chicago 39, Illinois.

TELETYPE®
CORPORATION
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Circle 663 on Page 17

SEALMASTER®

...quality that builds acceptance!

There is no greater assurance of performance than quality. SEALMASTER gives you that quality in a complete line of ball bearing units, providing a wide range of mountings in shaft sizes from $\frac{1}{2}$" to $4\frac{15}{16}$".

Patented SEALMASTER "Zone Hardening" affords simplified, secure locking to shaft. One piece housings eliminate loose pieces that increase your assembly costs.

The new SEALMASTER "L" Series provides a precision, low-cost line of self-aligning ball bearing units. Permanently sealed and pre-lubricated with a high grade lubricant for long life.

SEALMASTER rubber mounted units provide extremely quiet operation where noise is an important factor.

FOR quality—performance—economy—there's nothing comparable with SEALMASTER!

Write for Catalog 454.

"LP" PILLOW BLOCK

RUBBER-MOUNTED PILLOW BLOCK

SEALMASTER

BALL BEARING UNITS

SEALMASTER BEARINGS
A DIVISION OF
STEPHENS-ADAMSON MFG. CO.
22 RIDGEWAY • AURORA, ILL.

Circle 664 on Page 17

probes are removed, the resilient gel "heals" itself.

As a liquid, the gel has a viscosity similar to that of molasses. No damaging stresses are exerted on parts either during or after cure. Curing time can be varied from approximately 30 minutes to nearly 48 hours. Curing temperatures range from 40 to 150 C.

Catalog Describes Available Material Handling Films

AVAILABLE without cost is a new 16-page catalog listing 63 industrial material handling films that can be borrowed for company showings from member-companies of the Material Handling Institute Inc. The content of each film is briefly described and complete ordering information is given.

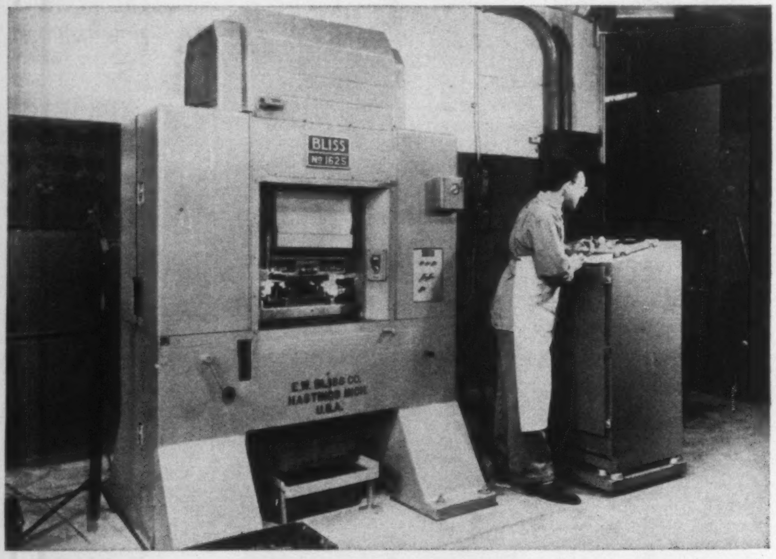
All films listed are 16 mm size and are available at no cost other than normal shipping and insurance charges. Equipment covered in the films includes monorail and crane systems, fork lift trucks, conveyor systems, pallets and racks, batteries, straddle carriers, packaging equipment, and many others. The films show handling operations in fruit and grocery warehouses, lumber yards, railway terminals, bottling plants, automatic transfer equipment, and pulp and paper industry.

Title of the catalog is "Industrial Material Handling Films." For your copy, write to: The Material Handling Institute Inc., One Gateway Center, Pittsburgh 22, Pa.

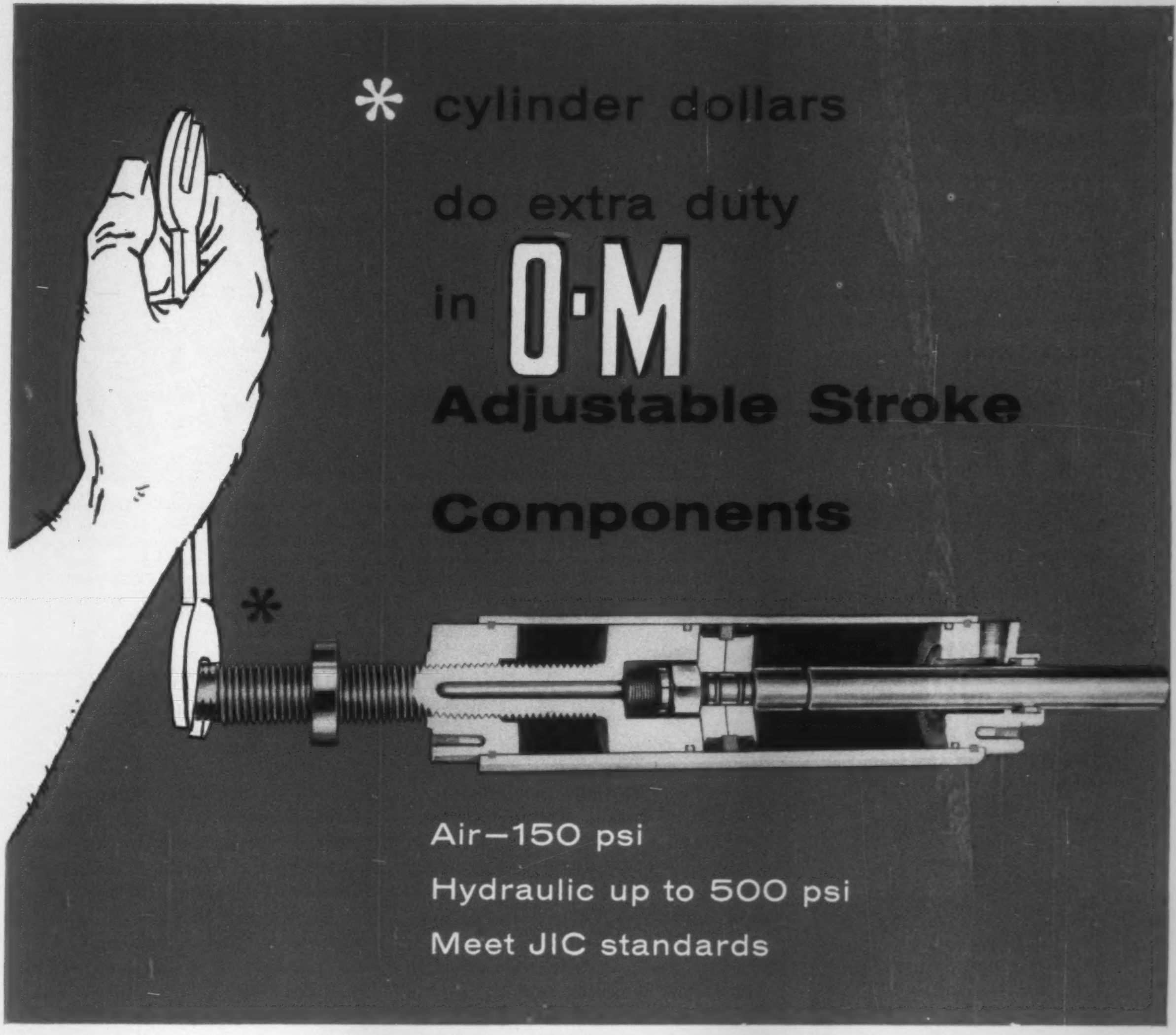
Complete Circuits Occupy Less Than Match Head Space

TAKING advantage of semiconductor manufacturing techniques such as controlled masking, etching, and diffusion, Texas Instruments Inc. has formed diode and transistor elements, as well as passive elements of resistance and capacitance, into integral parts of single pieces of semiconductor material. Using both silicon and germanium material, the resultant semiconductor solid circuits are about the size of the head of a match.

Two circuits have been developed on an experimental basis, and each measures less than $\frac{1}{4}$ by $\frac{1}{8}$ by 1/32 inch. One is a multivibrator circuit containing, as integral parts of the semiconductor material, the equiva-



OPERATING at 1000 strokes per minute, a new 25-ton E. W. Bliss Co. press is used to manufacture Truarc retaining rings at Waldes-Kohinoor Inc. Through the use of a triple-cavity die, the press stamps rings in a variety of sizes and shapes at a rate of 3000 pieces per minute. Coil strip, 0.050 inch thick by 3 inches wide, is fed into the press at a speed of 500 inches per minute. A light duty single roll feed pulls the strip through the press. The press has a $\frac{1}{2}$-inch stroke and uses a new counterbalancing system which works in opposition to force frequencies set up by the slide, thus minimizing vibration. Other design features include a recirculating oil system which provides lubrication to main bearings, connection bearings, and gibs; and an electric clutch which permits rapid torque pick-up and quick stops.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do extra duty
in O-M
Adjustable Stroke
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Air—150 psi
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Meet JIC standards

JUST a turn of the end on the adjusting rod and the stroke of this versatile O-M Cylinder is lengthened or shortened to fit the operation. This is accomplished with micrometer accuracy in a moment from the outside of the cylinder without disassembling or unmounting the unit or extra parts. Thus, you get the advantage of a special cylinder with no additional cost.

OTHER ADVANTAGES. Fits where others won't. All-steel construction with bearing surfaces of bronze. Designed right to seal right. Rod has high yield point. Can be disassembled and assembled faster than tie-rod types. Delivers continuous, smooth, dependable power at low or high speeds. Port can be oriented to any position. End plugs are tapped for universal mounting.

Available in a complete range of sizes (1½" to 8" bore) with standard, 2 to 1 or oversize rods. Also full line of mounting brackets interchangeable bore for bore. Immediate delivery on many sizes.

Mail coupon *TODAY* for Bulletin 112 featuring O-M Adjustable Stroke Air and Hydraulic Cylinders.

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O-M
CYLINDERS

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Circle 665 on Page 17

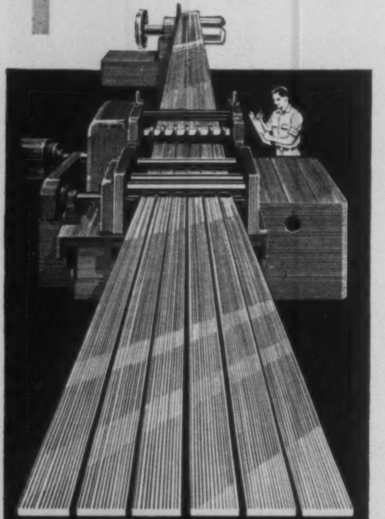
YODER

Rotary Slitters

Product dependability—integrity of manufacture—engineering for specific production needs have all contributed to establish Yoder equipment as the industry standard of excellence. Since 1909 Yoder-built machinery, including Pipe and Tube Mills, Roll Forming Equipment and Rotary Slitters, have earned world-wide customer satisfaction and recognition.

Profit from Yoder's years of engineering and service experience. Send today for the illustrated Yoder Slitter Book.

THE YODER COMPANY
5526 Walworth Ave., Cleveland 2, Ohio



ENGINEERING
YODER
MANUFACTURING

ROTARY SLITTING LINES
PIPE AND TUBE MILLS
(ferrous or non-ferrous)
COLD ROLL FORMING MACHINES

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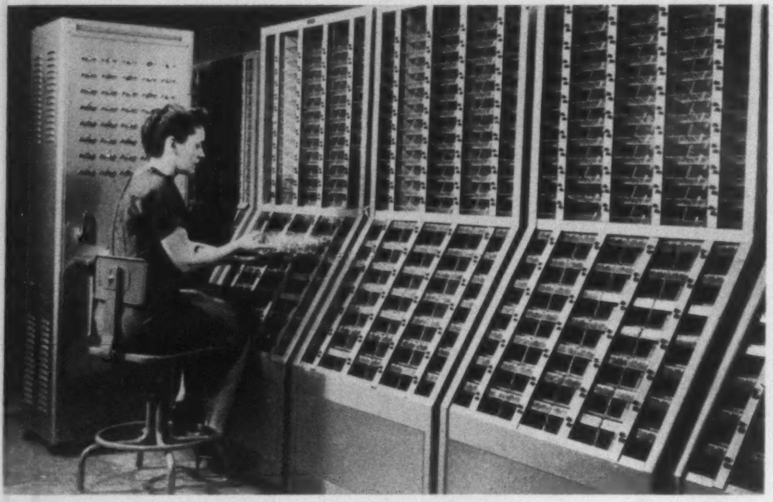


ELECTRONIC machine, designed and developed by the Semiconductor Div., Raytheon Mfg. Co., is used to test transistors as they flow from an assembly line and to sort the units into as many as 1200 different levels of performance. The operator places a transistor into a test socket and presses a starting button. The machine first tests the transistor and allocates it to one of four use categories: Computers, general purpose, entertainment, and specials. The machine then checks through a series of qualification levels in the selected category and classifies the transistor into narrow limits determined by its alpha cut-off level, collector cut-off current at high and low voltage, "punch-through" voltage, emitter cut-off current at high and low voltage, minimum beta, and input voltage. The classified transistor is then directed from the test socket into its proper bin in the sorting section of the machine.

lent of 12 electronic components—two diffused-base transistors, two capacitors, and eight resistors. The other is an oscillator circuit containing the equivalent of 9 components—five resistors, three capacitors, and one transistor.

With these development models, component densities ranging up to 34 million components per cubic foot are achievable. In contrast, a maximum component density of several thousand components per cubic foot has been realized with circuits using commercial techniques and printed circuits. Certain military applications have attained a density of 50 thousand components per cubic foot.

In announcing the new semiconductor solid circuits, Texas Instruments stressed that the units are development models and are not available in either sample or production quantities. However, the solid circuits are expected to be available for certain applications before the end of the year.

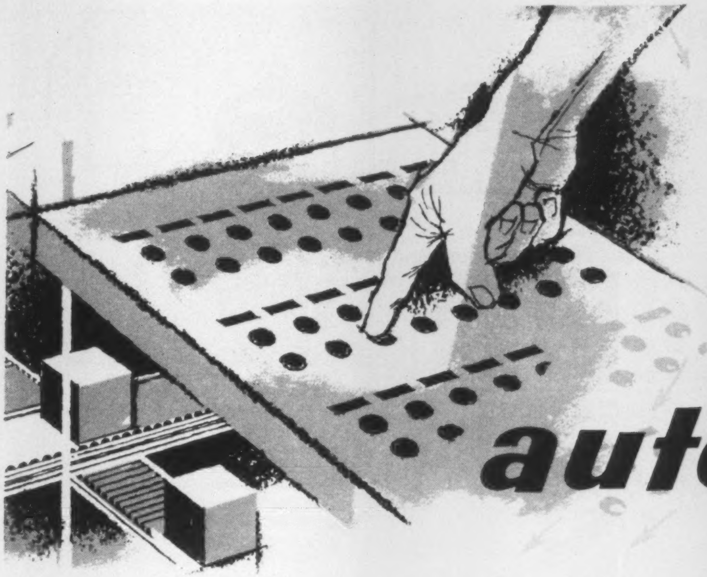
Joint Computer Conference

PLANS are underway for the Eastern Joint Computer Conference which will be held on December 1-3, 1959, at the Statler Hilton Hotel, Boston. As in the past, this year's conference will be sponsored jointly by the American Institute of Electrical Engineers, the Association for Computing Machinery, and the Institute of Radio Engineers.

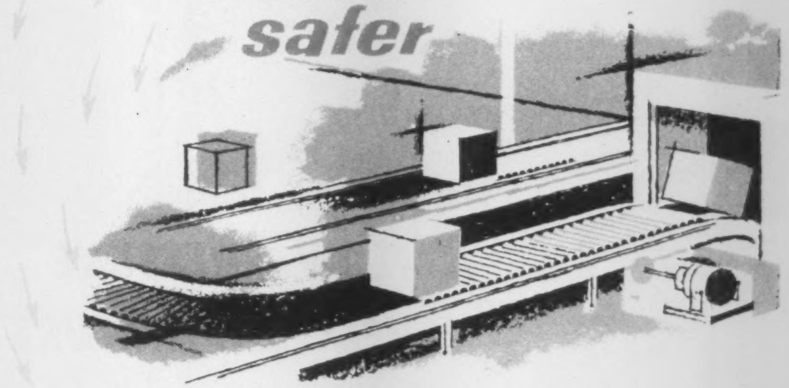
All phases of computing will be discussed during the 3-day meeting. Persons interested in details of the program or in submitting papers can contact **J. H. Felker**, EJCC Program Committee, Bell Telephone Laboratories, Murray Hill, N. J.

SPOTLIGHTING PEOPLE

Walter R. Forster appointed engineering manager of the Industrial Products Div., Westinghouse Air Brake Co. . . . **John L. Molner**, chief engineer, elected vice president of National Acme Co. . . . **Eugene B. Haynes** joined Waters Mfg. Inc. in the capacity of production manager. . . . **Donald H. Parrish** named works manager of Stromberg-Carlson—San Diego. . . . **Vincent J. Mankowski** appointed assistant director of research and development at Clearing Div., U. S. Industries Inc. . . . **Mark W. Cresap Jr.** elected president and chief executive of-



automatic handling... faster, safer



ANOTHER REASON WHY INDUSTRY MOVES
BETTER ON ALVEY-ENGINEERED CONVEYOR SYSTEMS

Automation doesn't necessarily involve extensive plant-wide integration of materials movement. Alvey comes up with many ingenious ideas and methods that automate materials handling of segments . . . lines . . . and departments within plants.

Alvey conveyor engineers keep their eyes on that **returnable** dollar. They create "pushbutton" movement of packaged goods and separate components—that not only saves time and manhours in the long run, but provides immediate returns on investment. Call us in to talk it over . . . no obligation!

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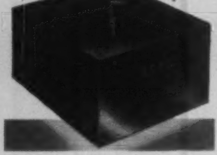
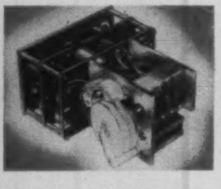
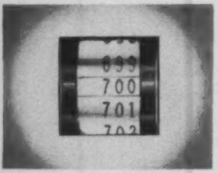
ROLLER, BELT, APRON, PUSHER BAR, SPIRAL, AND SLAT CONVEYORS • PACKAGE HANDLING SPECIALTIES

Circle 667 on Page 17







The NEW Series BH100

MILLI-V-METER*

DIGITAL READOUT

0001

ACCURACY 0.1%

SMALL SIZE — This compact, transistorized, servo-driven instrument measures only 3 x 5 x 5¾".

THE INSTRUMENT with the TAPE-SLIDEWIRE

ALL INCLUSIVE — With Zener reference, power supply, amplifier, servo motor, 144" tape-slidewire.

for FLOW · PRESSURE LEVEL · TEMPERATURE etc.

TAPE-SLIDEWIRE — Mounted on side-by-side spools, slidewire is embedded in edge of tape, punched for sprocket drive.

- Every scale division is a calibrated point.
- 100 calibrated points per foot of slidewire length.
- Slidewires up to 12 feet long.

PRINTED READOUT—Calibration printed on tape available to measure steady-state conditions or where input deviates more than 13%.

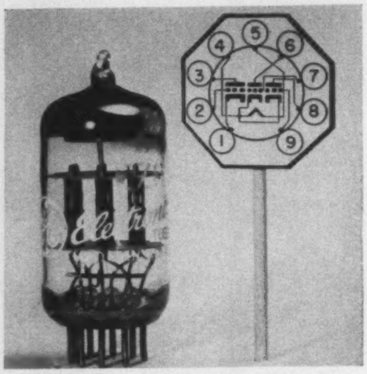
LINEAR, PARABOLIC, LOGARITHMIC FUNCTIONS ARE DISPLAYED IN DIRECT DIGITAL RELATION

* TRADE MARK

Full information is available for the asking!

B & H INSTRUMENT CO., INC.
3479 West Vickery Blvd. • Fort Worth 7, Texas

Sales-Engineering Offices: COMPTON, CAL., VALLEY STREAM, L. I., N. Y., DAYTON, OHIO, TORONTO, ONT. (George Kelk Ltd.), MITCHAM, SURREY, ENGLAND (Bryans Aeroquipment Ltd.)



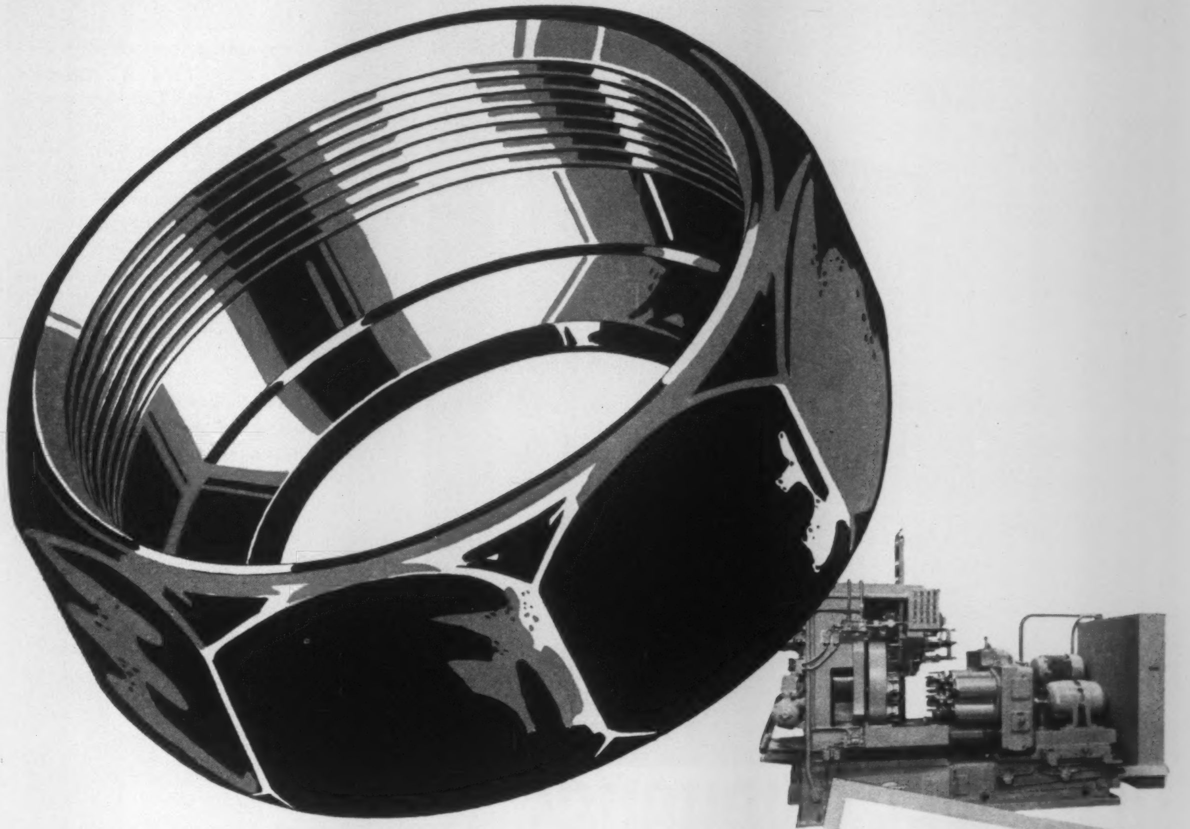
PRODUCTION of a triple triode receiving tube which can literally serve as a one-tube tuner for frequencies as high as the FM band has been announced by General Electric Co. Called the 6EZ8, the 9-pin minature tube packs a cumulative plate dissipation of 5 watts in one envelope. Each triode in the tube is rated for a maximum of 330 plate volts, 50 volts negative dc grid, and 2 watts plate dissipation. In a typical operation with 125 plate volts and minus 1 grid volt, each section has an amplication factor of 57, plate resistance of 13,500 ohms, and draws 4.2 milliamperes. Single tube can be used as an RF amplifier, oscillator, and mixer or as an oscillator, mixer, and AFC unit.

---

ficer of Westinghouse Electric Corp. . . . **Cedric F. O'Donnell** named chief of digital computers section at Autonetics, Div., North American Aviation Inc. . . . **Kendall C. White** appointed director of industrial engineering at corporate staff level for Thompson Ramo Wooldridge Inc. . . . **William B. Bergen** elected president of Martin Co. **Herbert G. Ryan** named assistant director of general engineering-receiving tubes for CBS-Hytron, Div., Columbia Broadcasting System Inc. . . . **George Cory** appointed chief engineer of Essex Conveyors Inc. . . . **E. J. Brandt** named manufacturing manager for Rectifier Div., Audio Devices Inc. . . . **James P. Falvey** elected chairman of the board, and **Robert H. Davies** elected president and a director of the Electric Auto-Lite Co. . . . **Dr. William C. Leone** appointed manager of Industrial Systems Div., and **Harold W. Ulmer** named manager of Electron Tube Div., Hughes Products Group, Hughes Aircraft Co. . . . **John DeMoss** appointed director of manufacturing for Poly-Scientific Corp. . . . **Joseph F. Degen** named vice president of operations for Weston Instruments Div., Daystrom Inc. . . . **Richard W. Lee** elected president of General Precision Labora-

Circle 668 on Page 17

...an example of Automatic Production by Greenlee...



700 malleable iron pipe fittings an hour...

The Greenlee 5 station, horizontal, automatic indexing machine shown above was designed and built for high-production machining of malleable iron pipe fittings. The pipe fittings are loaded, four at a time, indexed and machined at the rate of 576 to 712 pieces an hour, depending on size. The machine accommodates five different sizes of fittings.

STATION 1 — automatic load
STATION 2 — bore and rough counter-bore
STATION 3 — finish counter-bore and chamfer
STATION 4 — tap
STATION 5 — automatic unload

Let a Greenlee representative show you the modern Greenlee approach to automatic production.

MACHINES DESIGNED . . .
WITH THE FUTURE IN MIND

PRODUCTION MACHINERY
GREENLEE

TRANSFER MACHINES

GREENLEE STANDARD AND SPECIAL MACHINE TOOLS

- Multiple-Spindle Drilling and Tapping Machines
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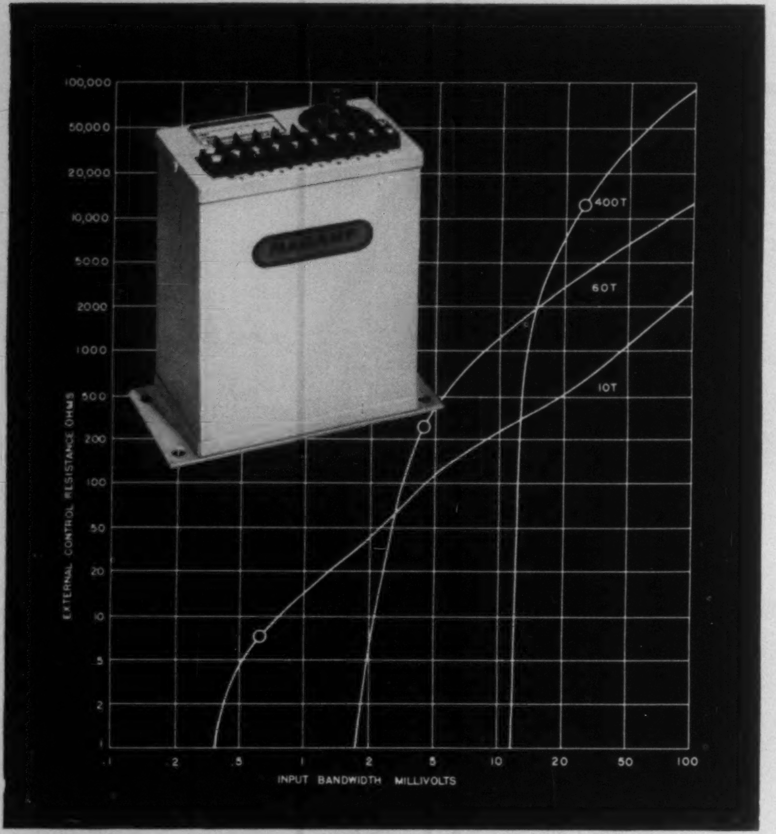
- Hydro-Borer Precision Boring Units
- Die Casting Machines
- Trim Presses

GREENLEE BROS. & CO.

1702 MASON AVE.
ROCKFORD, ILLINOIS

Circle 669 on Page 17



NEW WESTINGHOUSE BISTABLE AMPLIFIER

Ultra-Sensitive On-Off Static Amplifier

BISTABLE AMPLIFIER combines magnetic and transistor circuitry for an input sensitivity of 5×10^{-8} watts a-c or d-c. The output power is 6 watts at 24 volts d-c. This output is sufficient to drive auxiliary relays or static power amplifiers.

For current-control problems or voltage regulation, check these Bistable features:

- No tubes . . . no moving parts . . . no maintenance
- Exceptional sensitivity, 5×10^{-8} watts
- Multiple control windings
- A-C or d-c input signals
- Fast response . . . 20 milliseconds
- Economical . . . less expensive than relays
- Military versions available

GET ALL THE FACTS: Write Westinghouse Electric Corporation, Director Systems Department, 356 Collins Avenue, Pittsburgh 6, Pennsylvania. Complete information on the new Westinghouse Bistable will be sent to you by return mail.

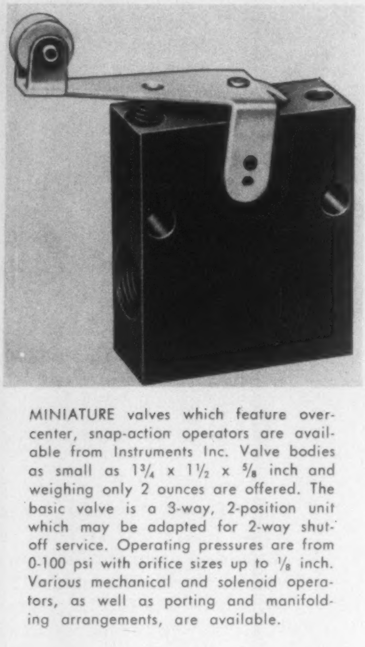
J-01009

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

Circle 670 on Page 17

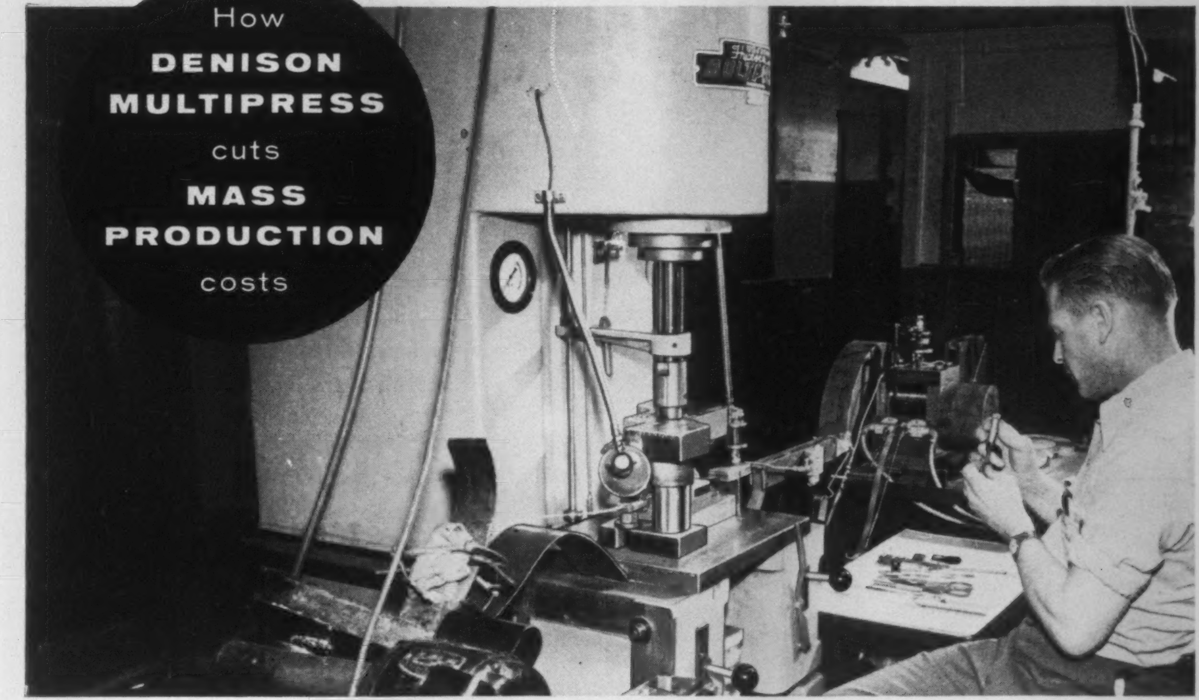
tory Inc. . . . **William P. Flohr** appointed chief engineer of Landis Tool Co. . . . **Herbert W. O'Farrell** named superintendent of manufacturing engineering for Summers Gyroscope Co. . . . **Fred A. Meunier** joined Magnaflux Corp. as senior engineer in the Electronic Engineering Dept. . . . **William Paul Novack** named supervisor of manufacturing engineering for Technical Products Div., Packard Bell Electronics Corp. . . . **Stanley Seitz** appointed co-ordinator of manufacturing engineering for American Electronics Inc. . . . **Alfred Doig Jr.** named chief engineer of Electronics Div., National Cash Register Co. . . . **Robert S. Lambert Jr.** appointed manager of manufacturing for Air Accessories Inc.



MINIATURE valves which feature over-center, snap-action operators are available from Instruments Inc. Valve bodies as small as $1\frac{3}{4} \times 1\frac{1}{2} \times \frac{5}{8}$ inch and weighing only 2 ounces are offered. The basic valve is a 3-way, 2-position unit which may be adapted for 2-way shut-off service. Operating pressures are from 0-100 psi with orifice sizes up to $\frac{1}{8}$ inch. Various mechanical and solenoid operators, as well as porting and manifolding arrangements, are available.

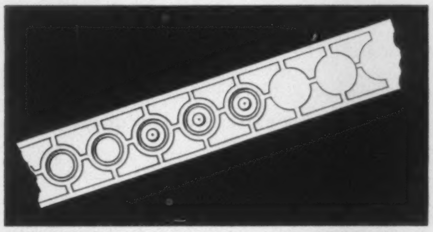
SPOTLIGHTING PLANTS

Sundstrand Machine Tool Co. has acquired all design, manufacturing, and sales rights to a line of automatic packaging machines, formerly produced by Brown Filling Machine Co. The machines are designed for automatic filling of liquids and powders into various types of packages and will complement Sundstrand's Packmaster line of automatic packaging machines. . . . **Systron Corp.** has purchased the assets and inventories of San Jose Scientific Co.,

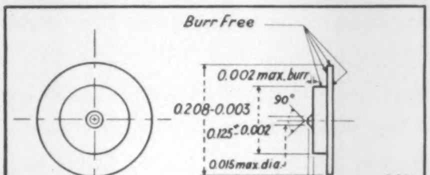


HIGH-SPEED LOW-COST COINING WITH HYDRAULIC MULTIPRESS at Minneapolis-Honeywell. Operating at 225 strokes-per-minutes, modified 8-ton Denison Multipress turns out 70,000 magnesium buttons a day. Automatic controls and safety limit switches permit one operator to handle 3 Multipress lines.

How **DENISON** *hydraulic* Multipress saves cash on high-speed coining for **MINNEAPOLIS-HONEYWELL**



3-STAGE PROGRESSIVE DIE advances strip .4375" with each ¾" Multipress ram stroke. Holes are used for piloting – and for stock advance with hitch feed.



EXTRUDED, COINED AND BLANKED from pure magnesium strip – this button is mass-produced at *extremely low cost* on Multipress. Stock sizing rolls control thickness of strip fed to die. *Denison hydraulic Multipress controlled pressure easily holds necessary precision tolerances.*

High-speed coining of small magnesium buttons is normally a mass production job for an automatic screw machine. *But, Minneapolis-Honeywell found it could do the job better and faster... save money, too... with Denison hydraulic Multipress.*

A modified 8-ton Multipress—equipped with 3-stage progressive die, 6-ton cylinder and special high-speed valves—mass produces about 70,000 of these ordnance-item buttons per 8-hour shift. Coining and blanking the buttons from coiled strip stock with Multipress – instead of using bar stock and a screw machine – *cut costs significantly on the operation.*

The progressive Multipress die—designed by Minneapolis-Honeywell engineers—has 3 working stations. *First station* pierces triangular holes which relieve strip and permit proper impact extrusion. *Second station* extrudes and coins parts to size – but leaves them intact in the strip. *Third station* blanks parts and moves them through the blanking die into waiting containers.

This is typical of hundreds of jobs that Denison Multipress does today throughout industry... to give users the *competitive edge.*

Denison hydraulic Multipress means important *plus benefits,* too – longer tool and die life... less scrap... better quality control... minimum maintenance... greater operator safety.

Isn't it time *you* got the story on Multipress... complete line from 1 to 75 ton capacities. Call or write your Denison Hydraulic Specialist on your very next job.

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1234 Dublin Road • Columbus 16, Ohio

Denison, Denison HydrOILics, and Multipress are registered trademarks of Denison Eng. Div., ABSCO

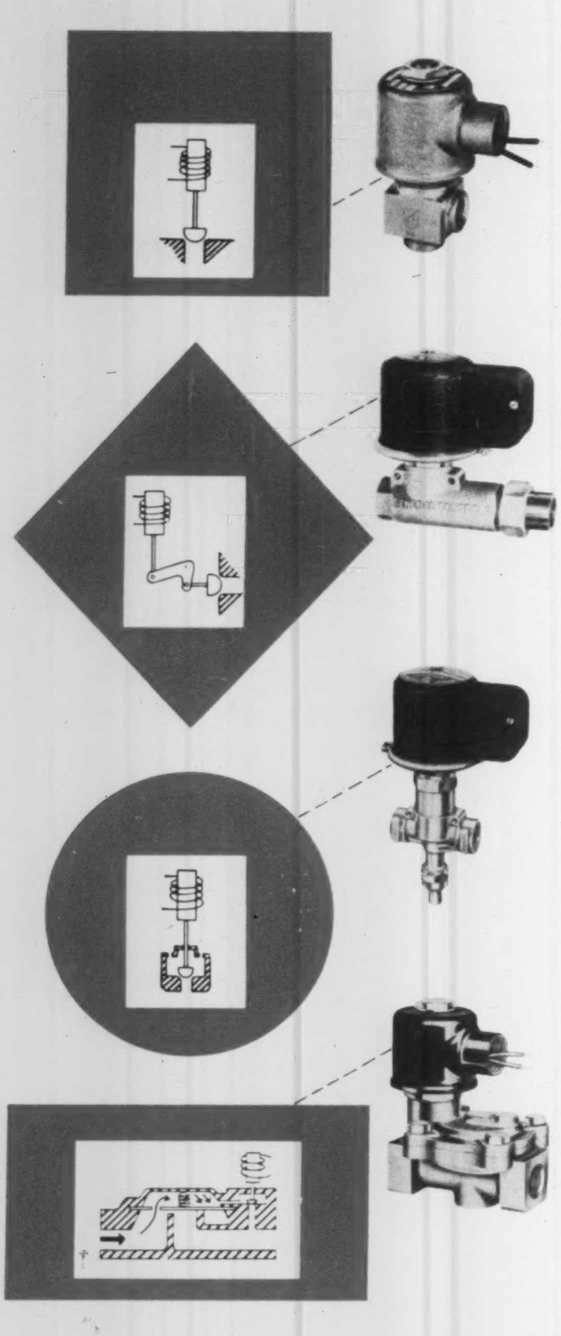
DENISON
TRADE MARK **HydrOILics**

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

Denison Stocking Branch Offices: LOS ANGELES • CHICAGO
DETROIT • ATLANTA • NEWARK • CLEVELAND • HOUSTON

Circle 671 on Page 17

why all SOLENOID VALVES aren't the same



DIRECT ACTING solenoid valve is a general purpose valve widely used where frequent operation demands a high operating life such as controlling high pressure air in a packaging machine. An example of this type of solenoid is the General Controls K-27. With only one moving part, the K-27 cycles for millions of operations. It is suitable for fuel lines, sprayers, vending machines, air or hydraulic applications.

LEVER ACTING valve for *high pressure* liquid lines. Has force ratio of 6 to 8 times greater than the direct acting valve. Opens against high pressure without dependence on impact action. The famous General Controls K-10 is widely used on primary safety shutoff in gas and fuel oil lines. Controls feed water, steam, air...an excellent general purpose valve.

PILOTED PISTON valve is designed expressly for *high pressure and high flow*. Uses line pressure to help open or close valve. Handles 12 to 15 flow mediums...water, air, gas, steam, petroleum derivatives, corrosives, freon and all types of refrigerants. The General Controls K-15 is one of the most widely used PILOTED PISTON valves.

DIAPHRAGM valve has no sliding surfaces, uses line pressure to flex diaphragm up or down to open or close. Excellent for high flow applications. The K-181, for example, has wide use in control of water to commercial dishwashers, air to plastic molding machines. It is extremely low in cost...in great demand where overall cost in production is important.

If you use solenoid valves, you're using one or more of these four basic types.

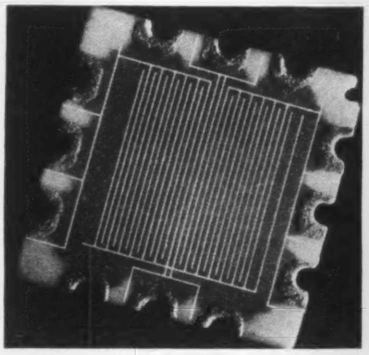
General Controls manufactures the proudest line of solenoid valves currently available. Just plain logic tells you GENERAL CONTROLS is your best single source for solenoids...and all the information and help you need. *Six* warehouses, coast-to-coast, 42 factory branch offices in the United States and Canada...guarantee the best in service before *and* after the sale. For full information, check the classified for your nearest factory branch office, or write:

GENERAL CONTROLS

Automatic Controls for Product or Process

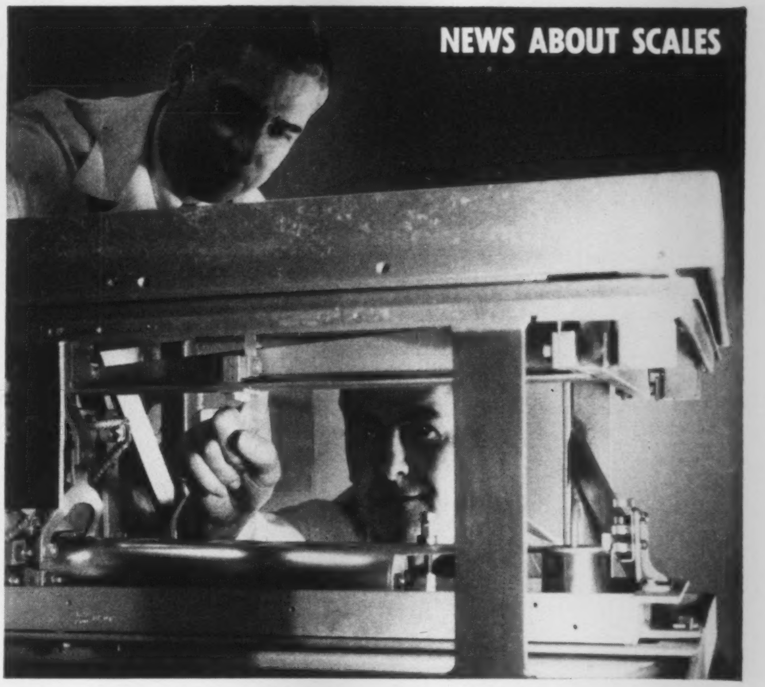
Glendale, Calif. • Skokie, Ill. • Guelph, Ontario, Canada

Six Plants — 42 factory branch offices serving the United States and Canada



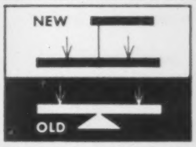
MICRO-MINIATURE resistor developed by Daystrom-Weston Instruments, Daystrom Inc., is in the form of a ceramic wafer which measures approximately 0.010 inch thick and 0.350 square. Retouched microscopic enlargement of a typical resistor shows how resistance characteristics are inscribed in the wafer. This element contains two resistors, and two more can be inscribed on the reverse side. The wafers can be designed for resistance values varying from 10 ohms to 1 megohm. By combining resistor wafers with other wafers containing transistor and capacitor elements, a module as small as a lump of sugar can function as an amplifier, oscillator, or other electronic subassembly.

manufacturers of strip chart recorders and digital voltmeters. . . . **American Telephone and Telegraph Co.** has announced that a $20 million research and development laboratory will be built by Bell Telephone Laboratories at Holmdel, N. J. with partial occupancy scheduled for late 1961. . . . **Fostoria Pressed Steel Corp., Chempump Corp.,** and **Zenith Engineering Corp.** are planning to merge into a combined company to be known as Fostoria Corp. . . . **CBS - Hytron Div., Columbia Broadcasting System Inc.** is changing its name to CBS Electronics effective July 1. The division — manufacturer of tubes, transistors, and other electronic components—is planning a $5 million expansion of its semiconductor operations to include a new 160,000 sq ft plant in Lowell, Mass. . . . **Vulcan Tool Co.** has acquired all patents, manufacturing, and selling rights to the Brehm tube cutting machine and cutting dies from Steel Products Engineering Div., Kelsey-Hayes Co. . . . **Robertshaw-Fulton Controls Co.** has started construction of a new $4 million plant at New Stanton, Pa., to increase production capacity of its Thermostat Div. . . . **Underwood Corp.** has acquired the Electrofile Corp. from Johnson Fare Box



How do they build unvarying accuracy into this remarkable new kind of weighing instrument?

For 7,000 years men have employed the multi-part pivot balance to compare weights. As the parts of their pivot joints wore, the problem of retaining accuracy became more and more acute. Then in 1956 the United States issued a patent for a "Thayer Flexure Plate" Leverage System. A team of engineers and businessmen, aware of industrys great cumulative loss of materials in weighing operations, had devised a revolutionary new scale. Knife-edge pivots that progressively wear and change were replaced by Thayer Flexure Plates that move only .001", yet accurately reflect the minutest changes in weight. This *firmly joined* lever withstands shocks and vibrations indefinitely. Dirt and dust are no longer a problem.



Thayer guarantees this leverage system accurate for the life of the scale.

How Can It Save You Money Year After Year?

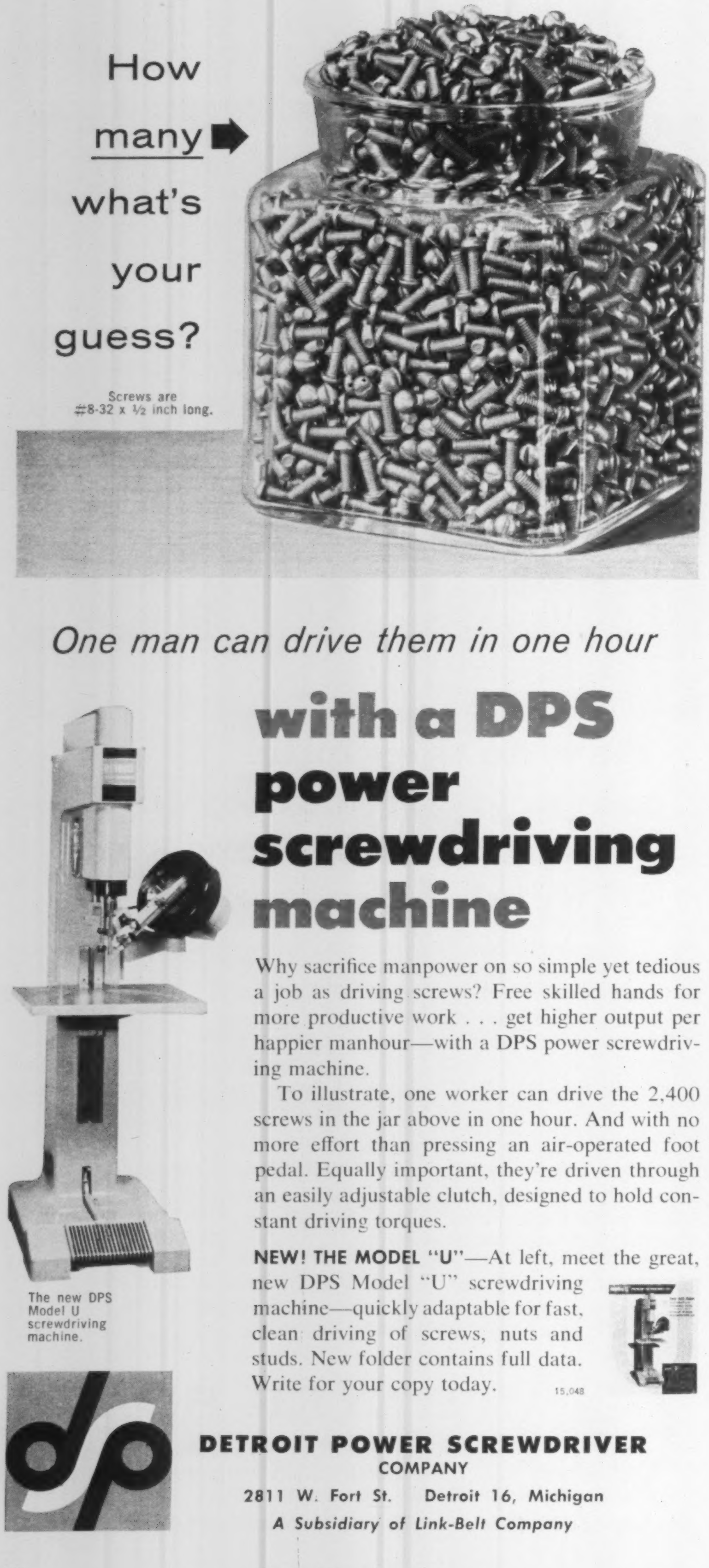
Working in conjunction with straight electrical controls, it forms the most reliable, low maintenance system ever devised to control processing or materials handling *by weight*. Literature on its application to filling, batching and checkweighing operations is available on request.

THAYER SCALE

AUTOWEIGHTION SYSTEMS FOR FILLING, BATCHING AND CHECKWEIGHING

THAYER SCALE CORP. • 5 THAYER PARK, PEMBROKE, MASS.

Circle 673 on Page 17



How many ➡ what's your guess?

Screws are #8-32 x ½ inch long.

One man can drive them in one hour

with a DPS power screwdriving machine

Why sacrifice manpower on so simple yet tedious a job as driving screws? Free skilled hands for more productive work . . . get higher output per happier manhour—with a DPS power screwdriving machine.

To illustrate, one worker can drive the 2,400 screws in the jar above in one hour. And with no more effort than pressing an air-operated foot pedal. Equally important, they're driven through an easily adjustable clutch, designed to hold constant driving torques.

NEW! THE MODEL "U"—At left, meet the great, new DPS Model "U" screwdriving machine—quickly adaptable for fast, clean driving of screws, nuts and studs. New folder contains full data. Write for your copy today.

15,048

The new DPS Model U screwdriving machine.

DETROIT POWER SCREWDRIVER
COMPANY
2811 W. Fort St. Detroit 16, Michigan
A Subsidiary of Link-Belt Company

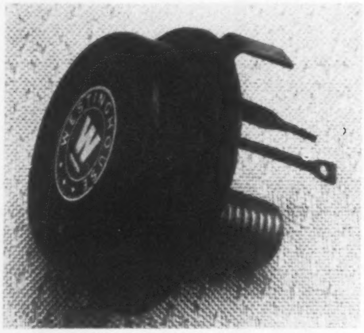
Circle 674 on Page 17

Co., subsidiary of Bowser Inc. The new acquisition manufactures electromagnetic filing equipment which codes, verifies, houses, and automatically selects original records. . . . **General Radio Co.**, manufacturer of electronic measuring equipment, is moving its headquarters to new offices at its plant in West Concord, Mass. . . . **Fuller Co.**, subsidiary of General American Transportation Corp., has purchased Traylor Engineering & Mfg. Co., manufacturer of mining, smelting, cement, and rock processing machinery. . . . **American Electronics Inc.** has formed an American Data Div. to handle the design, manufacture, and marketing of peripheral data processing equipment. . . . **Laboratory for Electronics Inc.** and **Servomechanisms Inc.** are planning to merge upon approval of stockholders of both companies.

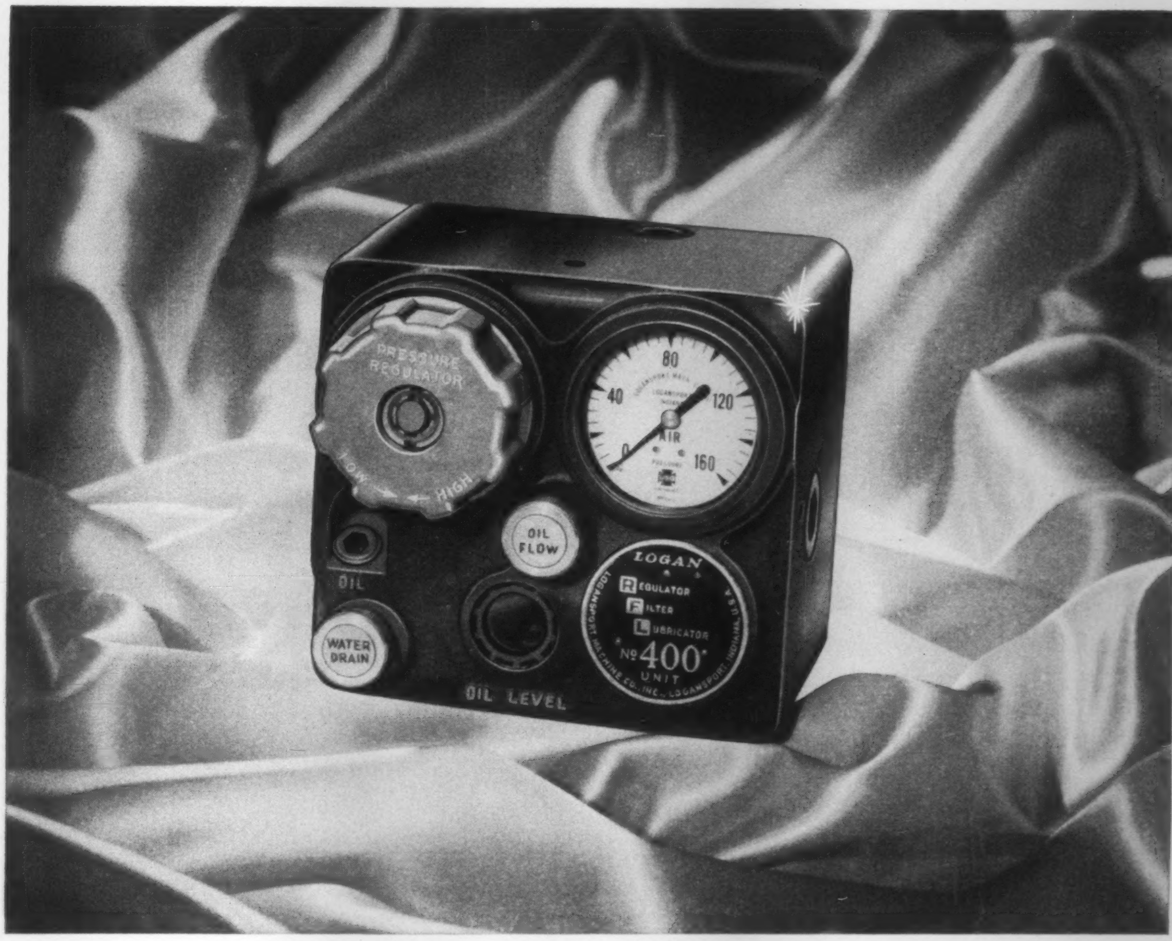
MEETINGS AND EVENTS

June 9-12—

Material Handling Institute Inc. National exposition of materials handling equipment to be held at Public Auditorium, Cleveland. Concurrent technical sessions will be sponsored by the American Material Handling Society Inc., Society for Advancement of Management,



TRINISTOR triode developed by Westinghouse Electric Corp. is a 3-terminal, multijunction silicon NPNP switch whose breakover voltage can be controlled by the base current. In the forward or conducting direction, the device will block up to full rated voltage until a base signal of 2-5 volts is applied. In the reverse direction, the unit will block up to rated voltage. The Trinistor can be applied in circuits with voltages up to 400 volts and currents up to 50 amperes. It can be used in place of thyratrons or as a converter, an inverter, a frequency changer, a variable frequency generator, a motor controller, or a voltage regulator.


PRESSURE REGULATOR
LOW
HIGH
80
40
120
AIR
0
160
OIL FLOW
LOGAN
REGULATOR
FILTER
LUBRICATOR
Nº400
UNIT
LOGANSPORT MACHINE CO., INC., LOGANSPORT, INDIANA, U.S.A.
OIL
WATER DRAIN
OIL LEVEL

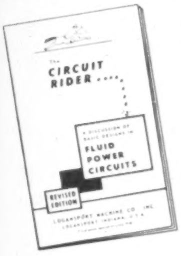
Illustrated—Logan Model 400 RFL Unit

Look to Logan

the ultimate in air circuit accessories

Logan RFL Unit, the designers choice for over a decade! Protects your air-powered equipment . . . regulates pressure . . . filters air . . . lubricates air. Adds years of dependable performance.

New Model 400, illustrated above, is a companion model to the well-known Model 600.


The
CIRCUIT RIDER ....
A DISCUSSION OF BASIC DESIGNS IN
FLUID POWER CIRCUITS
REVISED EDITION
LOGANSPORT MACHINE CO., INC.
LOGANSPORT, INDIANA, U.S.A.

FREE SEND FOR YOUR COPY OF THE LOGAN "CIRCUIT RIDER" A 32-page manual on fluid power circuits (fifth edition) completely revised to present current engineering trends.

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- ☐ 100-1 AIR CYLINDERS
- ☐ 100-2 MILL-TYPE AIR CYLS.
- ☐ 100-3 AIR-DRAULIC CYLS.
- ☐ 100-4 AIR VALVES
- ☐ 100-5 LOGANSQUARE CYLINDERS
- ☐ 100-5-1 ULTRAMATION CYLINDERS
- ☐ 300-2 PRESSES
- ☐ FACTS OF LIFE
- ☐ 200-1 HYD. POWER UNITS
- ☐ 200-2 ROTOCAST HYD. CYLINDERS
- ☐ 200-3 750 SERIES HYD. CYLINDERS
- ☐ 200-4 and 200-7 HYD. VALVES
- ☐ 200-6 SUPER-MATIC CYLS.
- ☐ 300-1 CHUCKS
- ☐ ABC BOOKLET
- ☐ CIRCUIT RIDER

TO:

NAME____________________ TITLE__________

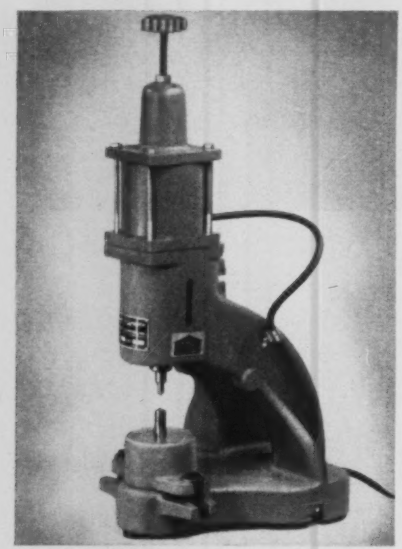
COMPANY ____________________________

ADDRESS ____________________________

Circle 675 on Page 17

LOOKING FOR THE IDEAL TERMINAL SETTER?

STOP. *You've found it. A Black & Webster Electropunch or full automatic Electroset can solve your terminal setting problems —for as little as* **$135.00**



SHORT RUNS: Electropunch — *sets hand fed terminals twice as fast as conventional methods. All electric. Foot switch operated.*

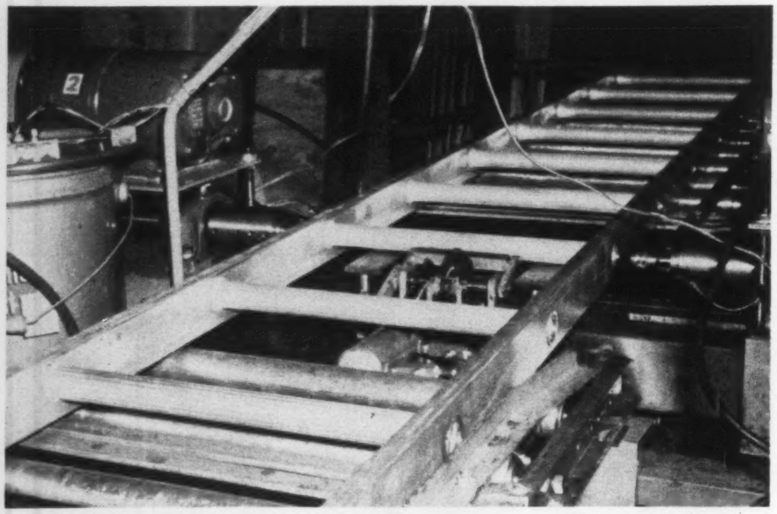
LONG RUNS: Electroset — *automatically feeds and sets terminals up to 3600 per hour. All electric. Customized to your needs.*

WHAT'S YOUR PROBLEM?
Black & Webster can help. Send sample terminal and requirements.

Write today for free 12-page catalog describing our complete line of production tools.

BLACK & WEBSTER, INC.
Dept. 2, 445 Watertown Street
Newton, Massachusetts

Circle 676 on Page 17



SPIN TOOL TABLE developed by the Carlson Co. and Automation Associates Inc. uses a pair of rapidly spinning tools under lateral pressure to perform operations such as drilling, forming, flanging, burnishing, spinning, and affixing parts by upsetting. Tool illustrated is flare peening aluminum tubing in the side rails of aluminum ladders. Two motorized spindles, mounted on opposite ends of a common support, simultaneously move toward the workpiece when triggered through a pneumatic relay valve. As the tools aproach the workpiece, they automatically slow down until they are seated firmly in the work. The tools retract after a given time cycle or when a back pressure has been reached, depending upon the type of control desired.

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and the Material Handling Div., American Society of Mechanical Engineers. Additional information is available from the Material Handling Institute Inc., Suite 759, 1 Gateway Center, Pittsburgh 22, Pa.

June 10-12—

Instrument Society of America. Second International Symposium on Gas Chromatography to be held at the Kellogg Center for Continuing Education, East Lansing, Mich. Additional information is available from Henry J. Noebels, ISA headquarters, 313 Sixth Ave., Pittsburgh 22, Pa.

June 14-18—

American Society of Mechanical Engineers. Semiannual Meeting to be held at the Chase-Park Plaza Hotel, St. Louis. For further information, contact ASME headquarters, Meetings Dept., 29 W. 39th St., New York 18, N. Y.

June 14-19—

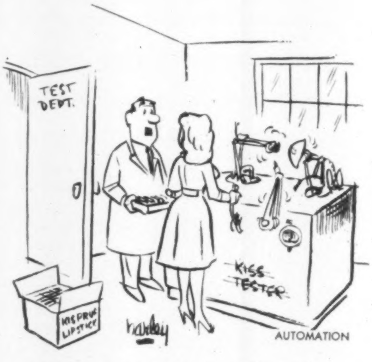
Society of Automotive Engineers. Summer Meeting to be held at the Chalfonte-Haddon Hall Hotel, Atlantic City. Additional information is available from SAE headquarters, 485 Lexington Ave., New York 17, N. Y.

June 16-19—

American Marketing Association. National conference to be held at Statler-Hilton Hotel, Cleveland. Additional information is available from William C. Gordon Jr., AMA headquarters, 27 E. Monroe St., Chicago 3, Ill.

June 21-26—

American Society for Testing Materials. Annual Meeting to be held at the Chalfonte-Haddon Hall Hotel, Atlantic City. Additional information is available from ASTM headquarters, 1916 Race St., Philadelphia 3, Pa.



"I can remember when it used to be fun working in this department."

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This Snyder transfer machine automatically weighs die cast aluminum pistons and mills them to tolerances of ± 2 grams at double the rate of the previous method. Here's how it turns out 600 parts per hour:

Pistons are transferred bottoms-up to orienting station.

Pistons are oriented in relation to the wristpin hole offset.

Pistons are spun right side up (below at right) while they are advanced to weighing station.

Precise overweight is transmitted by memory system to weigh-mill station during transfer.

A 3¼" milling cutter removes excess with the piston clamped in position.

Gaging station re-weighs pistons to check weight. Deviation from part tolerances stops machine.

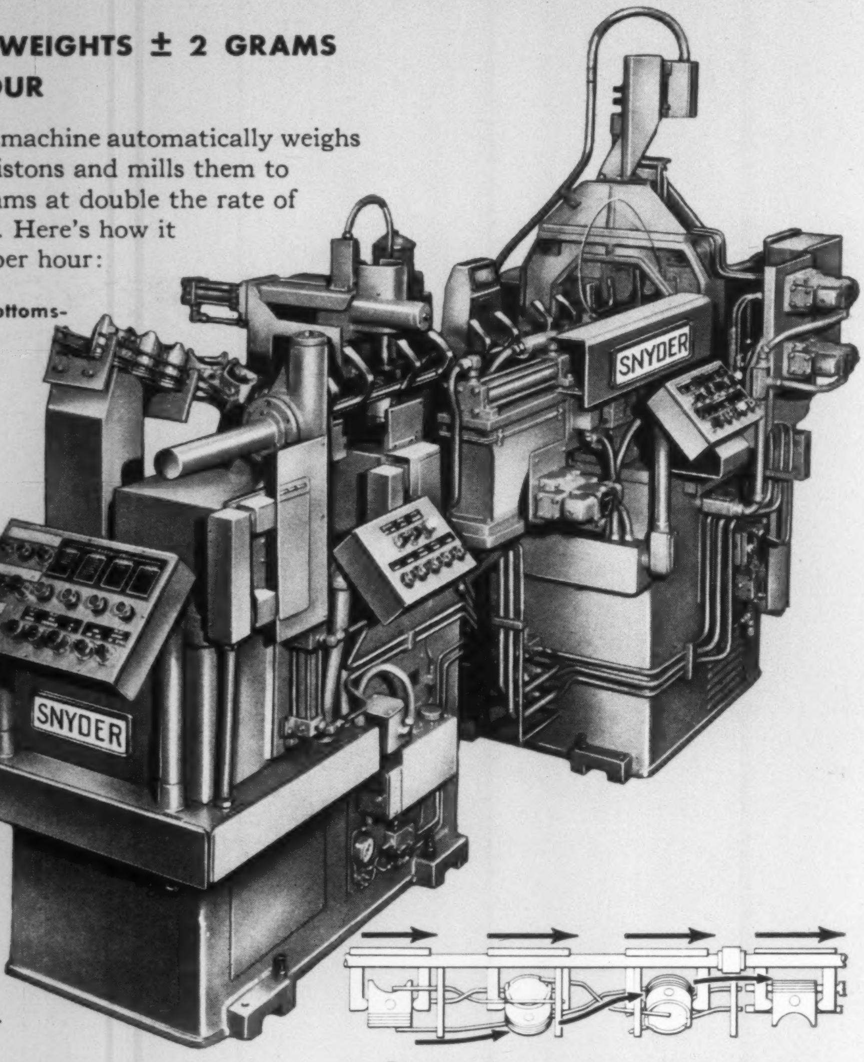

Diagram shows end over end rotation of piston as it passes through spiral rails.

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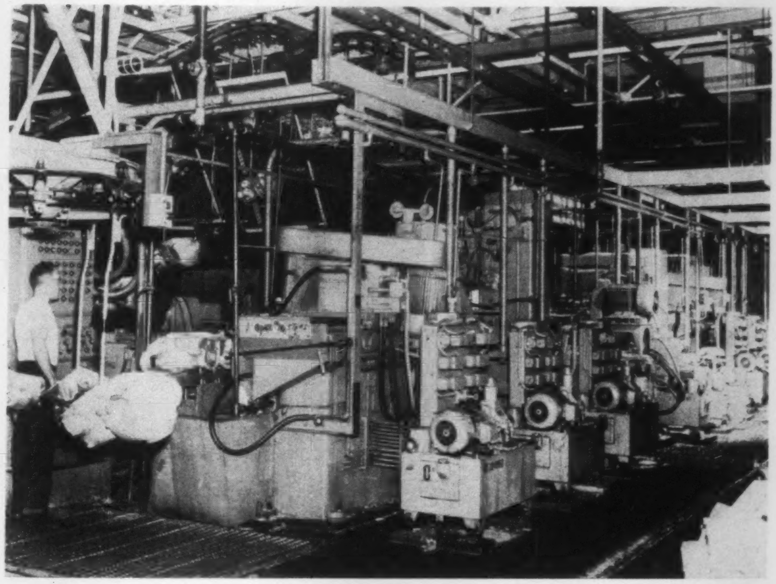
By **JAMES C. KEEBLER** Managing Editor



First machining section of 480-foot transfer line at Ford-Sharonville takes rough aluminum cases and target mills and bores surfaces for subsequent machining operations down the transfer line. This machine by Cincinnati Milling Machine Co. has 26 stations, 2 Westinghouse Cypak control cabinets, 1 pushbutton control console and 15 hydraulic pump and tank units.

Familiarity Breeds Security

THOSE who ply the trade of specifying manufacturing processes and the production equipment to make them tick should be awarded "hazardous duty pay."

Gamblers

As the complexity of automatic production machinery increases, the man in the manufacturing engineering function spends more time on the carpet. He specified this red-hot method and approved these whiz-bang machines, and right now the blankety-blank contraptions are spitting out parts at the rate of zero pieces per hour. In short, it's shut down. Why?

This type of circumstance has created for the manufacturing engineer, and the equipment designers he employs, a terrific interest in reliability of components. If things are running well, there's a long-shot chance he may get a compliment, if things don't run consistently, there's an even better bet he'll need unemployment compensation. The hazard is compounded by the fact that if they decide to play everything conservative and not venture past the categories of their previous experiences into the realm of doubt, the cards are stacked in favor of the competitors that run risks (and do so successfully).

What the equipment user faces would probably even scare a bookmaker. What is the probability that given Component A on Station 1 of Machine 650 will last for a million cycles? What are the consequences of various types of failure? How long will it take to find the trouble? How long to fix it? What cost?

Familiarity

In the specification of the components for equipment systems familiarity breeds security. This is true also with the maintenance of the line. The top-notch troubleshooter not only knows what to kick to make it tick, but also knows on what side to kick it.

Standards, such as the JIC codes, help those who adopt their use. The systems that conform represent proved techniques that have become familiar to the engineers and operating men that will have to live with the equipment. Similar motives prompt the adoption of "Approved Source Lists" that require use of components whose familiarity has spelled security for those who specified their use.

To those who fear that standardization stifles progress and results in stagnation there is the reminder that familiarity can also breed contempt. Where trouble spots repeatedly reflect the same sources of downtime, the contempt for offenders can mount to large proportions. Those who offer alternatives get a receptive hearing.

Moving Parts

Illustrating this point is the problem with contacts in switches and relays. Pitting, burning, and sticking of these moving parts causes failure to properly make or break the required electrical circuit and can cause erratic action or failure of the control system. Where the proper component, properly applied does the job there is no complaint. Where the number of millions of cycles expected, the inherent problems of the design, or the improper selection or application results in failure the contempt rating rises.

Static switching devices that have no moving parts have been introduced as an answer to the problem. Used in place of relays these units rereceive control signals which can change the state of output to load to be either *Off* or *On* as desired. This is accomplished electrically without mechanical change in the device. Characteristics of the units available make circuit design feasible that parallels computer circuit techniques, using logic functions to describe the control actions. Now instead of thinking merely in terms of "normally open" and "normally closed" the circuit designer considers also *AND*, *OR*, and *NOT* func-

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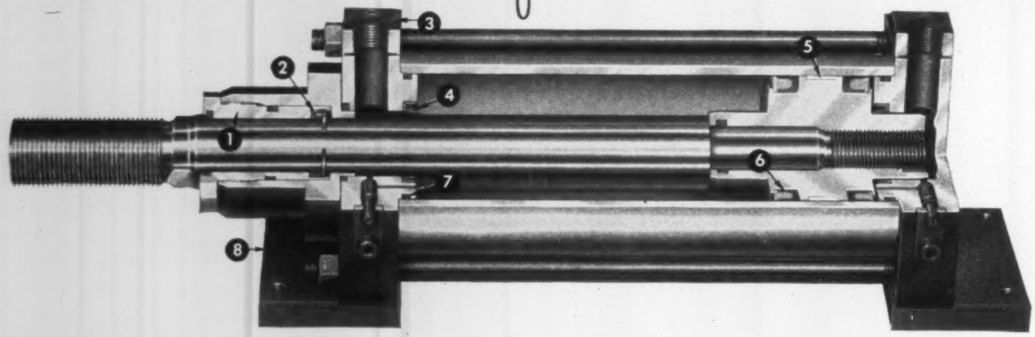

❶ **EXTRA-LONG NOSE GUIDE** provides maximum bearing area for piston rod . . . assures peak resistance to side-loading deflection of rod and piston.

❷ **CARTRIDGE SEAL** assembly is designed for quick on-the-machine servicing . . . can be replaced without any disassembly of the cylinder.

❸ **REMOVABLE PORT ADAPTERS** allow fast exchange of complete cylinder assemblies for bench servicing . . . time consuming piping operations are eliminated.

❹ **SELF-ALIGNING CUSHION SEALS** assure uniform cushioning throughout cylinder life . . . unique one-way seal eliminates need for cushion ball check.

❺ **TEFLON* WEAR STRIP** on piston prevents metal-to-metal contact between piston and bore . . . scuffing or scoring of bore surface cannot occur.

❻ **NYLON-BACKED PISTON CUPS** for air service, or Teflon-backed O-rings for hydraulic applications, provide positive, bubble-tight sealing throughout the cylinder's operating pressure range . . . keeps break-loose pressures low.

❼ **POSITIVE BARREL SEAL,** with full-width metal-to-metal contact between barrel and heads maintains leak-free sealing . . . holds dimensional stability under maximum stress.

❽ **RE-USABLE MOUNTS,** with precision-fit load bearing slots, handle heaviest operating loads with ample safety factor . . . are easily changed for modification or re-use of cylinder.

**Trade name for duPont tetrafluoroethylene resin*

8029

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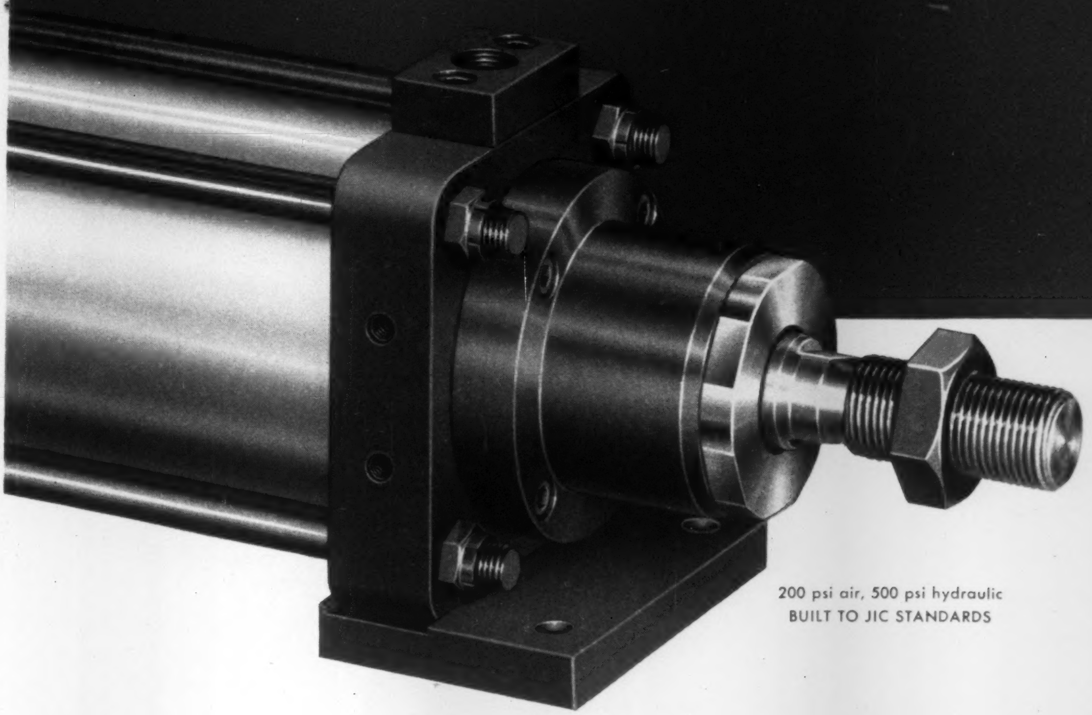

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tions.

Despite the fact that such functions, their symbols, and the very use of static control elements are not covered in the JIC Standards, one of the large installations of static control equipment is to be found in the Ford Motor Co. automatic transmission plant at Sharonville, Ohio. This fact is in itself evidence that the automakers are not so staid in their ways as to overlook the possibility of advancement. The quest for reliability is a strong force.

The plant and equipment are so new that long term comparison figures between static control systems and more conventional counterparts are not available. However, with 19 transfer machines from seven sources, with grinding and finishing machines from three builders, and with Westinghouse and General Electric static components in use, it would appear that this place could be considered more than a mere trial balloon for a new idea.

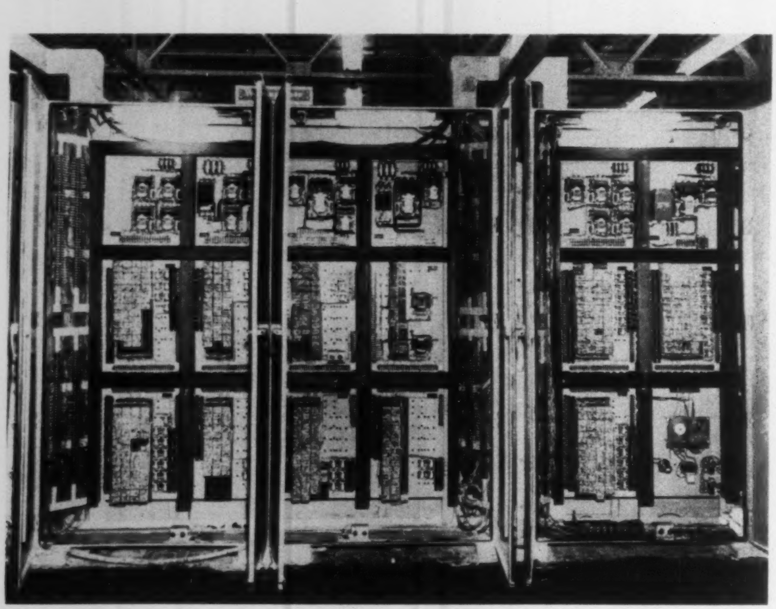
Experience gained in the design, construction, installation, and servicing of this type of component was reported in a paper presented at Westinghouse's 23rd Annual Machine Tool Electrification Forum by Ford's Ivan L. Hosek, equipment engineer, Sharonville Plant, and Westinghouse Industrial Engineering Department's Norman L. Caban.

Ford found it necessary to set up ground rules to cover construction of the static control systems. These served the purpose usually fulfilled by JIC specs. Manufacturers were provided with requirements pertaining to desired machine sequences and control safety features. Among these was the stipulation that circuits pertaining to specific machine functions be "packaged" as control system modules, and that these modules be positioned in the cabinet so as to be consistent with the location of machine stations. Requirements pertaining to location of manual control stations, wiring practices, drawings, and the numbering of electrical components were also set up. It was required that an indicator lamp be provided for each input from pilot devices on the machine and each output. The use of single-pole relay amplifiers between static control and solenoid valves was approved.

Some builders fabricated the control systems themselves, others purchased this equipment from the components builders. In place of a conversion procedure from an existing relay control system, it is recommended that the static system be designed directly, using sequence of operation lists, hydraulic circuit diagrams, and bar charts showing operation of pilot devices. Cypak system designers need to be familiar with the characteristics of the elements, apply intelligent use of phase sensitivity, and make optimum use of *OR* circuitry if they are to achieve space conservation and economy of components. Economies can be realized by modular construction that takes advantage of the technique of carrying a single signal to many modules with a single lead.

Unfamiliarity of shop wiremen with this system necessitated more detail in the drawings than is normally required for relay controls. Hosek and Caban also report that the terminal arrangement on the Cypak blocks has resulted in a major timesaver in the interwiring of modules and the AMP connector has proved to be entirely satisfactory.

Use of static control elements in control panels does not eliminate limit switch problems. The most serious problem that arose involved machines equipped with static limit switches into which coolant was able to work its way, thus causing many failures. Ford engineers feel that there is a definite need for a limit switch that is not mechanically actuated and which is impervious to the action of coolant and moisture. They further feel that machines should be designed with this type of switch in mind.



One of two Westinghouse Cypak control cabinets for Cincinnati Milling transfer machine at Ford-Sharonville contains 27 motor starters, 57 control relays, 470 Cypak modules, 1108 dual terminal points and over 1000 incoming wires. Line voltage equipment is at top of enclosure with all low-voltage controls at bottom.

Security

This type of development offers more reliable operation, but its success depends on familiarity. The point is well summed up by quoting the last paragraph of the Forum paper: "Machine tool builders have acquired substantial, valuable experience in supplying the controls for these machines. Much of the alleged mystery that surrounded this type of control has been removed and many advantages of static control systems that had been recognized have been brought into the spotlight. As machine tool builders become more familiar with the application of static control, and as more standards for the use of static control are developed, many of the disadvantages and problems that arose as a result of this effort will be eliminated."

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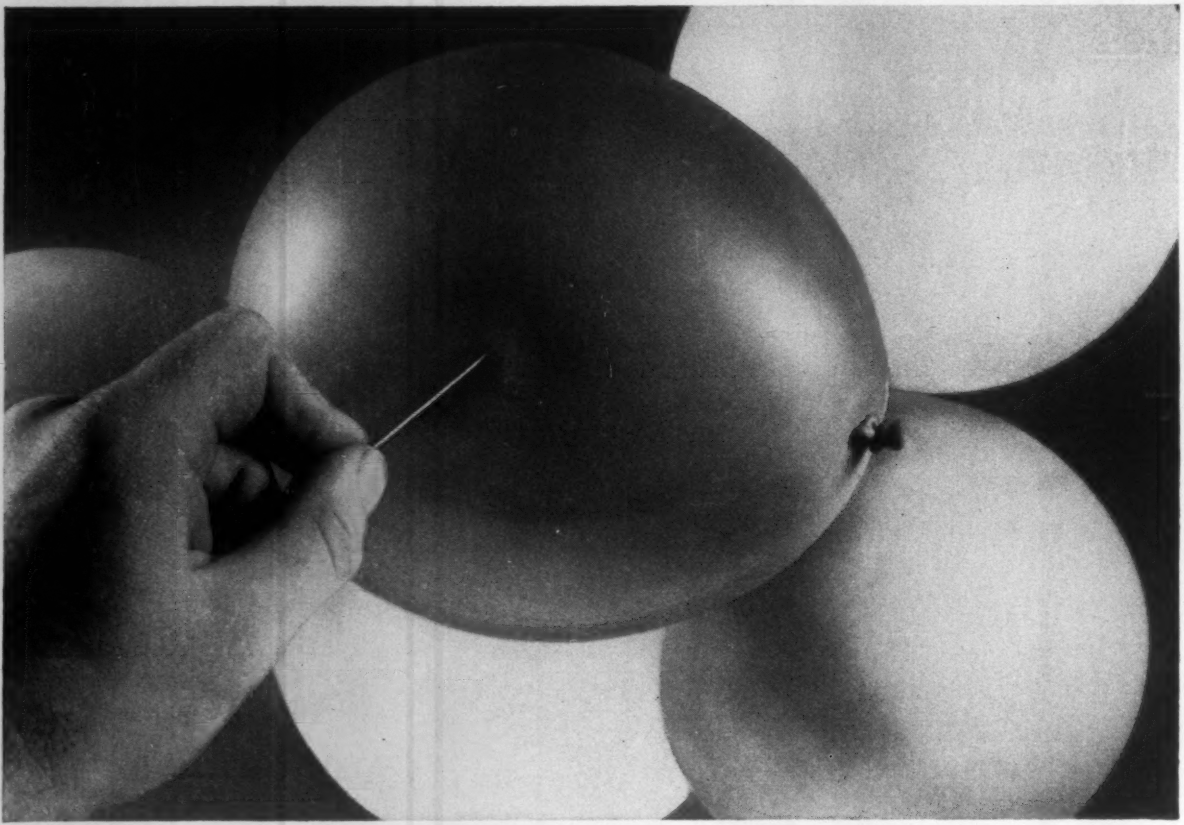

Machine Tool Buyers:

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Almost without exception, machine tool replacement formulas employ an erroneous factor in computing savings — they are based on *today's* labor rates.

It seems basically sound to suggest, in the case of a contemplated investment in equipment, that a projection be made as to the estimated period over which the equipment is to be used.

Assuming this to be ten years, it is a fairly simple matter to project the *average* wage rate over the next ten years by using the historical increase for the past several years. This increase is known to be from 5 to 6% per year.

Using 5%, we then have a simple computation to determine the average projected wage rate which should be used in computing savings in a replacement formula.

Assuming a current wage rate of $2.50 per hour, this becomes $4.07 per hour at the end of ten years, or an increase of 62.8% over today's labor rate.

This percentage increase could reasonably be applied also to other factors in the computation of savings, such as indirect labor, fringe benefits, maintenance, etc.

In contemplating the purchase of a piece of equipment which will last for a number of years, it is fallacious, therefore, to compute savings in terms of today's costs only.

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western trends

By PATT PATTERSON
Los Angeles, Calif.

Preprogrammed Broadcasting

PERHAPS unaware of it, listeners of late night radio programs on auto or home radios have probably heard at least one station using completely automatic, unattended programming. For today, more and more radio stations are using automated programming equipment for evening, night, and weekend service.

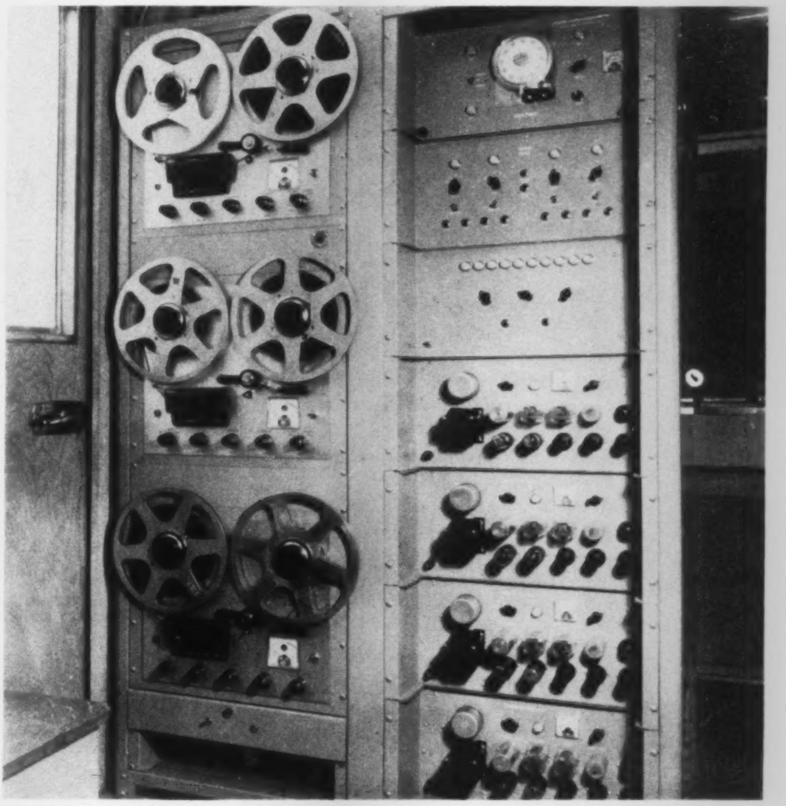
With the advent of television, all-night and weekend radio programs have posed major economic problems for the radio station operators. Generally, higher costs have not been offset by increased revenue from commercial announcements for such lower audience periods. But with automatic programming, equipment may be installed at the transmitter site, with no attention except starting and stopping at the beginning and end of the broadcast period.

The way it works is illustrated by equipment developed by Schafer Custom Engineering, Burbank, Calif. During the regular live broadcasts, announcers at the studio prepare their music lists and announcements for the night or weekend shows. When the program has been planned and roughly timed, the announcer enters a broadcast booth and the control room engineer switches the output from the announcer's microphone to a program preparation unit.

This unit is a tape recorder with special control equipment added. The control equipment includes a sub-audible signal generator and a "sound monitor"—a device which detects periods of silence, and switches off the tape drive. The signal generator produces a 25-cycle tone which is below the level of human hearing. This tone, however, serves as an actuating signal to start other equipment, such as record players or other tape recorders.

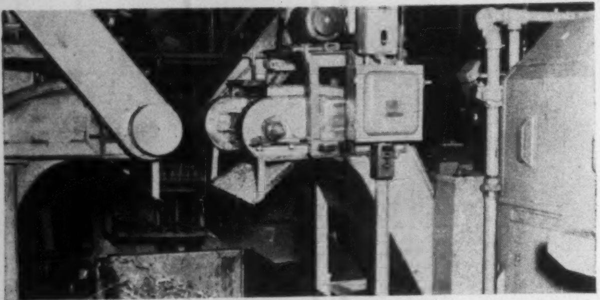
The announcer reads his introduction to a commercial and pauses. This silence halts the tape recorder. A recorded commercial from either tape or disc is then fed onto the announcer's tape. At the end of the commercial another period of silence stops the recorder again. The announcer then starts the tape, reading his introduction to a record. At this point he has two choices. He may either again use silence as a key for starting the music, or he may push a button which records the 25-cycle tone on the tape while he is talking. At the time the tape is played back on the air, this 25-cycle tone will key in the proper record, which will start playing as a background to his voice.

This same sequence is followed for the entire program, which may be of two to six hours or more duration. A six-hour program may take only an hour to two hours to pre-



Unattended programming is new trend in radio broadcasting. Tape unit shown here is installed in transmitter building. After studio personnel leave for the day, the program unit is switched on and broadcasts with no supervision except for transmitter personnel who operate other equipment. A system would include a library record player, which stores records. Control equipment switches back and forth from tape to records to produce a complete program. The tape recorded announcements are prepared by studio personnel during normal working hours.

MAY-FRAN CHIP-TOTES



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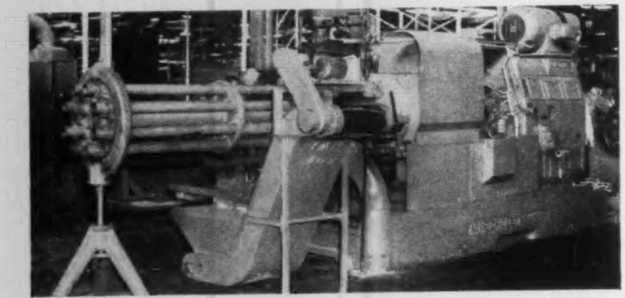
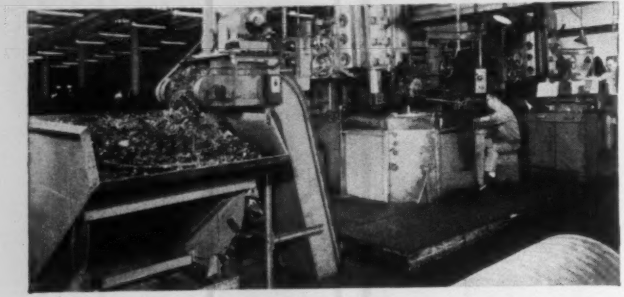


CONTINUOUS SCRAP REMOVAL



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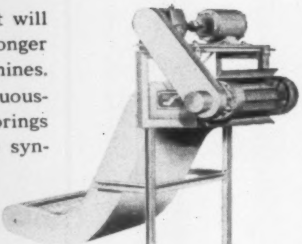

Here is a machine tool accessory that will cut production costs, and permit longer "run" times for your automatic machines. The MAY-FRAN CHIP-TOTE continuously removes the chips, turnings and borings from machines. The conveyor can be synchronized with the metal removing capacity of the machine. Scrap is channeled onto the CHIP-TOTE belt, carried clear of the machine for discharge into tote box or carry-off conveyor system. There is a CHIP-TOTE for every machine tool.

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Circle 681 on Page 17

pare in this manner, however.

At the automatic program broadcast unit, the announcer's tape, containing his announcements and record introductions, is placed on the tape playback. When the studio staff go home for the day, a signal is given the transmitter engineer, who starts the automatic unit. When the tape reaches the first cue, it triggers another tape recorder, or a special library record unit, which can play up to 100 records (45 rpm) in order. At the completion of a record, the brief silence turns off the record player unit and switches on the tape drive again. The duration of the periods of silence may be adjusted, resulting in just as "tight" a programming schedule as is possible with live studio personnel.

Tape playback units and library record players may be ganged to accommodate enough material to play for 48 hours. Or two units of each may be used, with the transmitter personnel (who must be on duty at all times the transmitter is on the air) changing tapes and reloading a new batch of records while one unit is playing.

Equipment of this type is usually available to the stations on either a purchase or lease basis. Many radio station owners find that the increased revenue from all-night programs and unattended weekend programming pays back the cost of the equipment in a matter of months.

Other special equipment is also available. For example, there is a special console which permits a control room operator to select any one of 99 prerecorded commercials or special announcements by pressing buttons indicating the desired commercial.

Special timing equipment brings station breaks at the proper times, adjusting the program format to the time advance or lag necessary. Station breaks, however, never interrupt music or announcements, but are phased in between. For newscasts and special bulletins, the program format may be interrupted without affecting the sequence or the timing of the show. Control equipment, operating in a real-time keyed basis, permit the insertions and automatically advance the program sequence.

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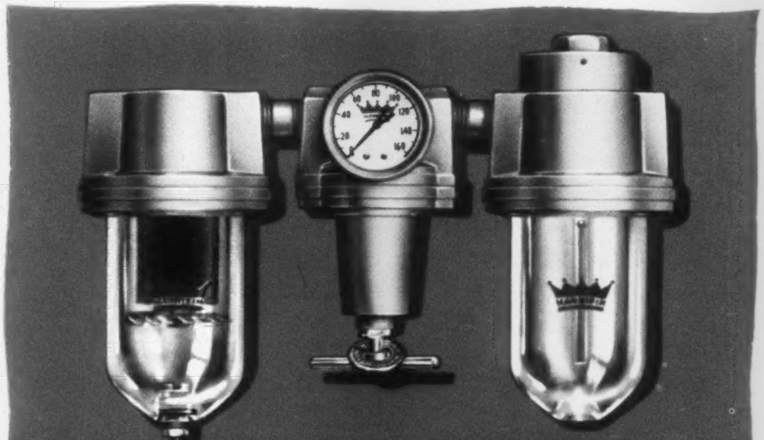
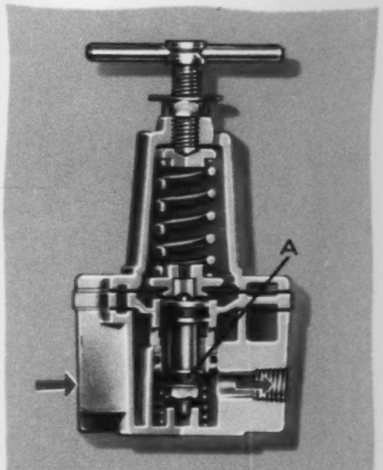
PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS

From HANNIFIN *Crown* air preparation units that don't waste air power



Complete, compact, CROWN "matched units" available in any combination you may require, sizes ¼" through 1".



Hannifin regulator design enables oversized poppet (A) to open to full-pipe capacity in a very short stroke. Direction of flow eliminates chatter. Standard models self-venting.

Hannifin CROWN "Combo" units – filters, regulators and lubricators in any combination – keep compressed air in the "pink of condition" without depriving you of needed air flow.

Crown regulators open fast on demand, close precisely when demand is satisfied, deliver the exact amount of air needed. Their "piston balanced" poppet design, which makes possible a flat, large-area, poppet-type valve with very short stroke, is the reason. The inherent stability of this design – no hunting or chatter – results in multi-million cycle life.

Crown filters have large, reusable filter elements for minimum resistance to air flow. Crown lubricators introduce predetermined amounts of oil into the air stream, automatically. Their design is so responsive to variations in air flow rate that the concealed, tamperproof adjustment is rarely used. This is the easiest lubricator of all to fill, and remote-fill models are available.

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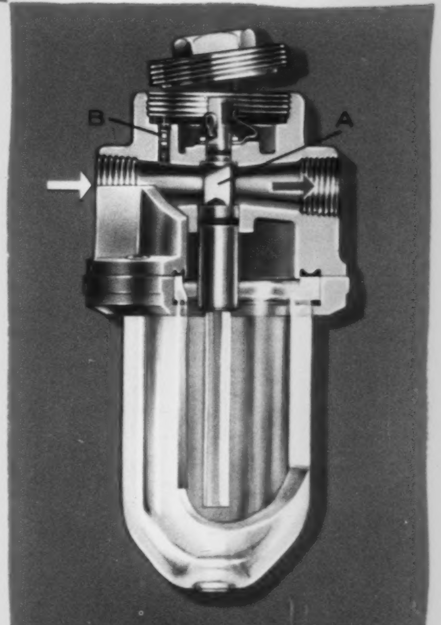

Lubricator vane (A) is factory pre-set for most applications. Valve (B) shuts off air pressure to bowl when fill plug is removed. This patented Hannifin feature permits bowl refill without shutting down air line.

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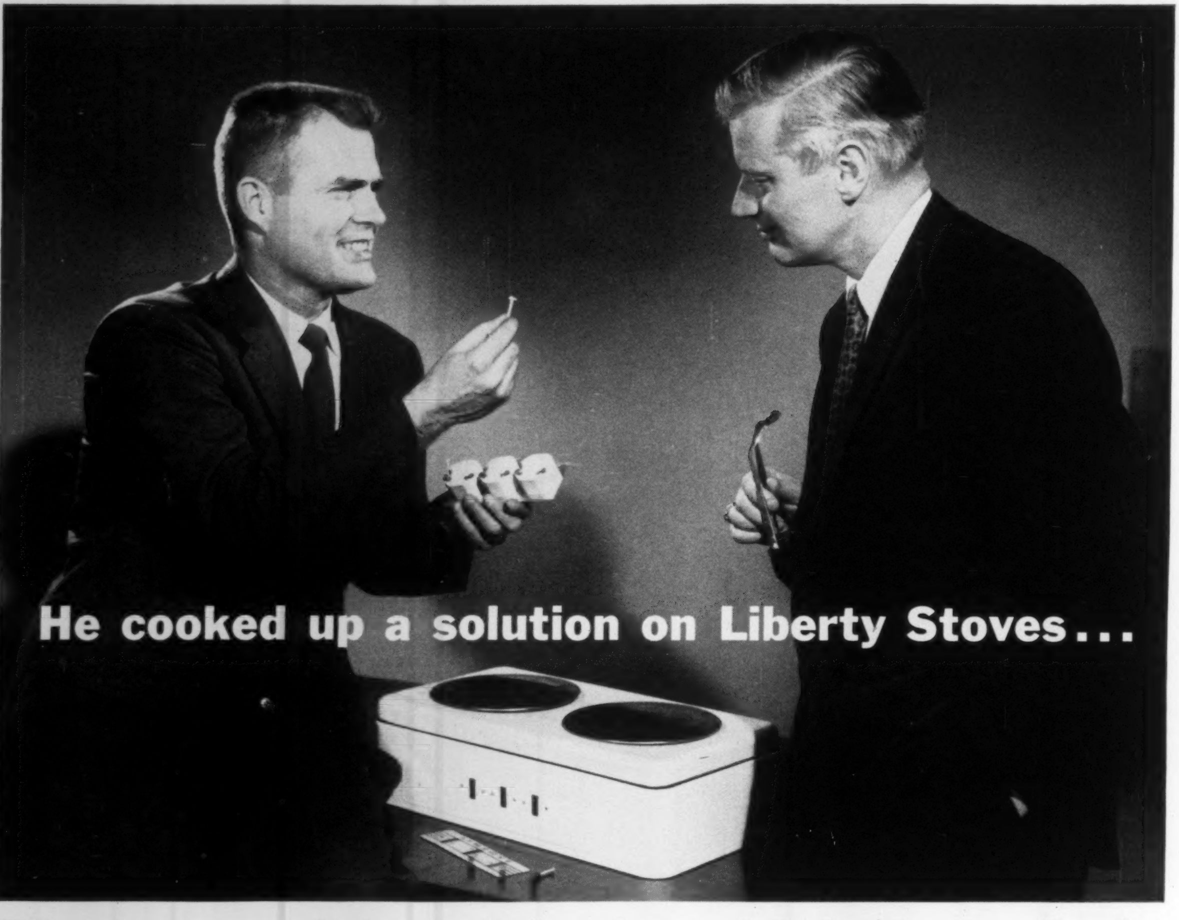
He cooked up a solution on Liberty Stoves...

Riveting porcelain switches let 1 girl do the work of 6

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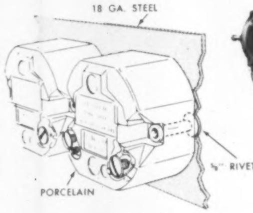

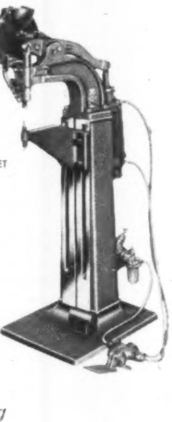

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AUTOMATION

JUNE 1959

Odds

Top authorities in the field of automated equipment design agree rather uniquely on one fairly critical point. This point is that it is rarely possible to estimate accurately the cost of an automatic machine or processing system that has never been built before.

Even the most experienced estimators frequently can be off as much as 50 per cent, often 100 per cent and occasionally, on complex automated lines, they may miss by 200 per cent or more. Why?

The answer lies largely in the unpredictable amount of preliminary analysis, manufacturing process research, engineering, and try-out or pilot operation time involved. The risk of inaccurately predicting these costs places an undue burden on the equipment builder. Either he or the buyer may lose.

In the day of simpler standardized equipment, research and engineering charges could easily be written off over years of sales. No one piece of equipment included any sizable portion of such expenses in its price. Capitalized value basically represented the cost of building.

Today, a major part of the cost of automated equipment of the one-of-a-kind variety can be attributed to analysis, process development, engineering and system proving-out. These are rightly research engineering charges and should be treated as such. To include such expenses as an integral part of the cost of building equipment, places unnecessary restrictions on production development. To treat such expenses as capital investment improperly inflates equipment values.

Manufacturing management knows the tremendous advantages in automation but too often cannot risk the odds present in gambling with unpredictable equipment costs. It is high time for management to recognize and accept manufacturing research rightfully as expense, machinery build costs properly as capital investment, regardless of whether equipment is developed in-plant or by production equipment builders. Adoption of this realistic, uniform, and practical approach will open new opportunities with the odds heavily favoring both buyers and builders.

EDITOR

MINIMIZING RISK AND DEBUGGING IN DEVELOPING UNIQUE EQUIPMENT

By **RICHARD S. WHITE**, President, Automation Engineering Laboratory Inc., Greenwich, Conn.

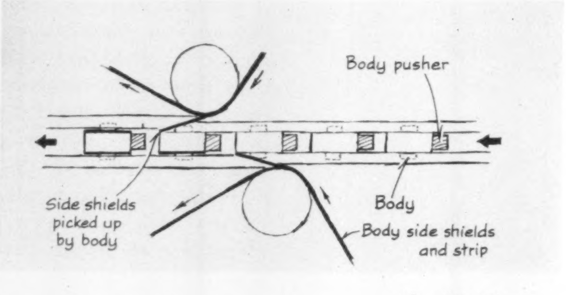
THOSE PEOPLE familiar with industry, and particularly the introduction of new equipment to industry, are familiar with the word "debugging." Many have come to believe that debugging is an ever present part of the development of new processes, methods, and machinery. In fact, articles have been written to very properly advise managements that they should recognize the significant role that debugging will probably play in progressive programs that they undertake.

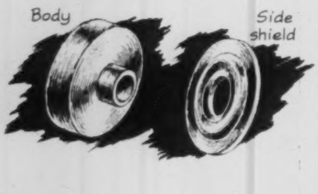
The method of automation that will be described in this article is not claimed to be a panacea for debugging, but it is presented as a method to drastically reduce the scope and degree of debugging, and to eliminate possibilities of total failure of a new process or a new production machine, after the equipment is built.

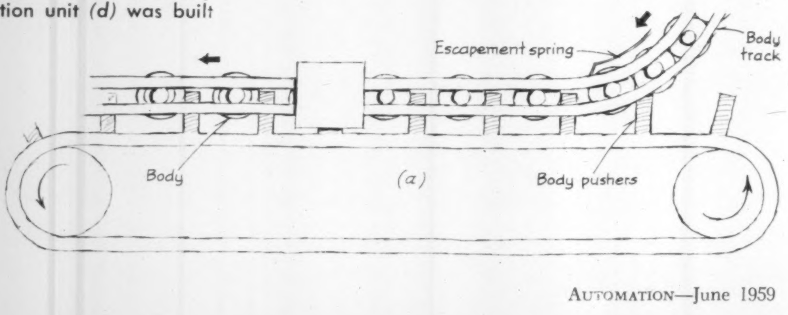
This is tremendously important from the viewpoint of management which must authorize expenditures for automation and from the viewpoint of the engineers who are responsible for completion of the projects. The big fear often present in men's minds when asked to consider a new automation program is "How big is the risk?" "How can we be assured that the program will be a success?"

When we set out to develop a new process, or a new method, or a new application of a method, we must *invent* how we are going to do it. This

Phases in step by step development are illustrated for the assembly of thin plastic discs on plastic cores. Sketch at *(a)* records general layout of method thought feasible for this operation. The method was proved out as at *(b)* by a working model. The inexpensive model established angular requirements for removing a disc from a strip and picking it up on the core, and proved that the concept was sound. Sketch *(c)* illustrates one type of drawing that might be made in working out the design of the production unit. For speed of operation and a compact machine, the method proved on a straight-line basis was translated to a rotary design, but proved conditions were carefully maintained. Finally, the production unit *(d)* was built and tested.





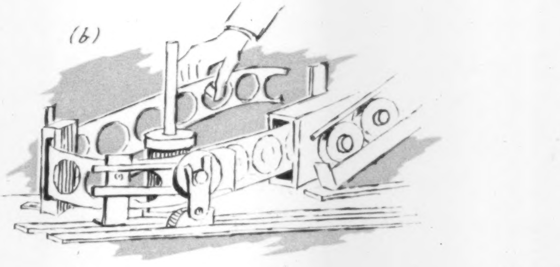


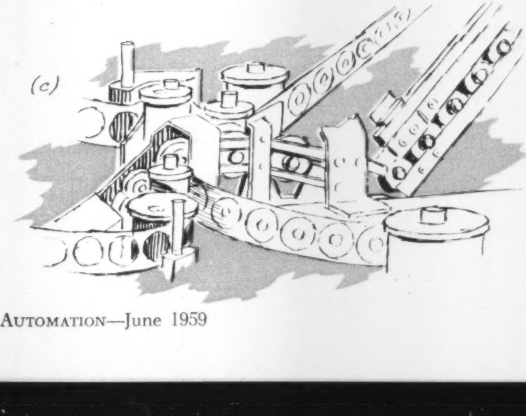
A systematic step by step approach in developing equipment for new methods and processes can eliminate major financial risks. Ability to perform planned functions can be determined with a minimum of risk by proving them out on working models. Debugging efforts required after equipment is fabricated are reduced by less-costly corrections made in preliminary stages.

process of invention must look at the whole and then gradually bring into complete focus the details of each of the parts.

As one starts to invent, he creatively imagines something that is not an existing three dimensional reality—and in fact he doesn't *start* to invent, he searches for ideas and if he is blessed with inventiveness they come to him then, tomorrow, while he shaves, as he drives, next week, or sometimes next month.

These ideas, these things his imagination puts before him, are usually a composite of parts. And each of these parts must work together. Thus each part must be brought into partial focus and examined for reality, and for use in the whole process or machine, before the detail of a gear drive has any pertinence whatsoever to any part or to the whole.





▶ Lay Out the Methods

When an engineer, or a group of engineers, starts to create a new process or bring into being a new machine, he or they must have a means of expressing the over-all method, or composite of methods, which they conceive to be appropriate for the objective to be achieved. Furthermore, this expression should be in some simple form which can readily transmit thoughts to others who are concerned with the project. Word descriptions or discussions about the methods are a poor means for this initial communication. They particularly leave a great deal to be desired from the viewpoint of later reference back to the thinking that was foremost at this initial stage of a project.

Thus, Step 1 in a new automation program is to prepare general layouts of the methods that are conceived. These layouts should show the devices and functional members of the equipment that are intended but they should not take on the characteristics of finished assembly drawings at this stage. It is important that concepts be indicated but not frozen. Also, alternatives for the important functions should be shown in separate drawings or in written discussion notes with reference to the basic or recommended methods.

These indicated methods should then be fully discussed with the production people who are going to use this new process or machinery. It is very important that both the production people and the machinery engineers have considerable respect for the thinking, experience, and contributions of each other. Out of such a conference will often come either some modification of the original thinking or emphasis on certain critical aspects of a segment of the methods.

▶ Prove Out In Models

At this point there should emerge, in fairly clear focus, those parts of the proposed methods that are the most critical or questionable. The degree to which one may be truly certain or uncertain about functionability at this stage is expressed by the typical comments: "If we can be

sure to pick up this particular paper product with this type of mechanical fingers, then the rest of the operations will be quite straightforward as we will have firm control of the parts." It is this factor of "if" that must be watched. Or, "if this cooling time is adequate with this type of rubber coating, then the parts will set up in the time and space allowed." Or, "We know this is a critical operation, but if we bring the parts together in this manner, we think we can handle the tolerances which are involved."

The important point is that it is *thought* but not *known* that these methods will work. In other words, it is not *known,* without reservation, that these new, proposed methods will work. If it was, the project would not involve new, untried territory in which management is concerned about the risk that is involved.

Engineers would do well to be humble and communicate fully with management people. Commonplace are the arguments "Why I've been doing this type of thing for years, I know it will work"; but is it exactly the same?. Isn't there something different about this product, or the way to handle it, or the variables that have to be controlled, or the conditions that must be sensed and information fed into the machine to tell it what to do? If such is not so, then it should be possible to use many of the drawings of existing machinery and merely modify grouping of the parts, capacity, etc. But if this is not an often repeated tapping operation, or common method of folding paper, or extruding candy, or of winding wire, etc., then *Step 2 should be to prove out that what is thought to be workable actually will work.*

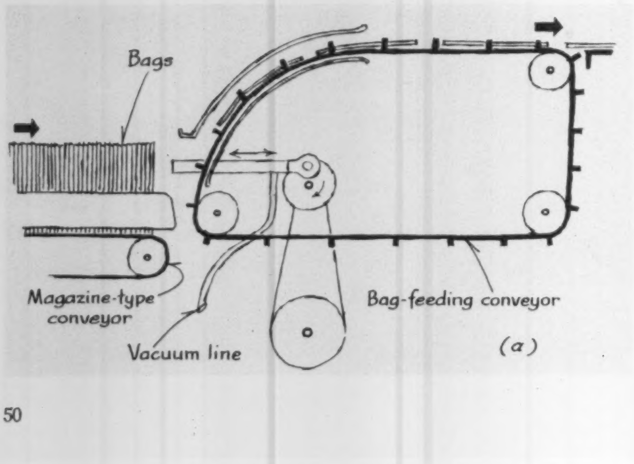
Here is where the step by step approach differs most from traditional and widely used procedures for developing new processes and designing and building new equipment. This stage of a project is not the time to prepare the complete design of a new unit of machinery. True, many factors can be calculated or closely estimated, but yet how often groups of very competent engineers have brought forth machines or process equipment that in fact did not work. Too often engineers are high pressured (or persuaded) into designing a new process or a new type of equipment without proceeding through adequately careful steps, or without allowance for economic and/or time parameters that are sound.

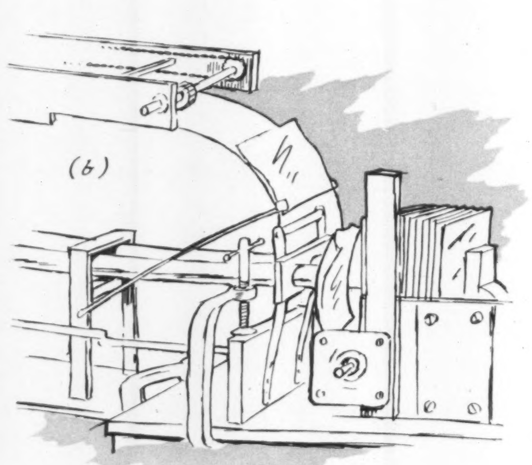
The sound way to proceed from the point where concepts have been presented and reviewed is to prove out in a working model each of the basic methods involved with doing the job. These working models need not be fully designed with an idea to production or maintenance requirements. In fact they can often be rather crudely constructed, but they must perform without special manual assistance the function which they are to prove. Though the model may rely on manual performance of uncritical auxiliary functions, the model must operate without manual aid of the functional aspect.

If, for example, one of the functions to be performed is to pick up a thin plastic disc via the travel of a plastic core, a model can be contrived to show that each time the core passes the side at a certain and determined angle, it does in fact wipe on the disc. When such a function is actually demonstrated to the production and management people responsible for authorizing an engineering development, they and the development group both then know that a production unit based on the demonstrated method will work.

Think of the risk that is involved in developing new equipment which is expected to run into sizable proportions—let us say $250,000 as an example. It is a very considerable burden on management to authorize such a program if they cannot witness functional performance until 90 to 95 per cent of the total cost of the program has been spent. In contrast to that risk exposure, we have found

Development of equipment to transfer bags from a magazine also illustrates the step by step approach. Rough layout at *(a)* presents general features of method conceived. Feasibility of vacuum extraction and transfer of bags was proved out in model *(b)*. When production unit *(c)* was designed and built it incorporated improvements checked out on the model.



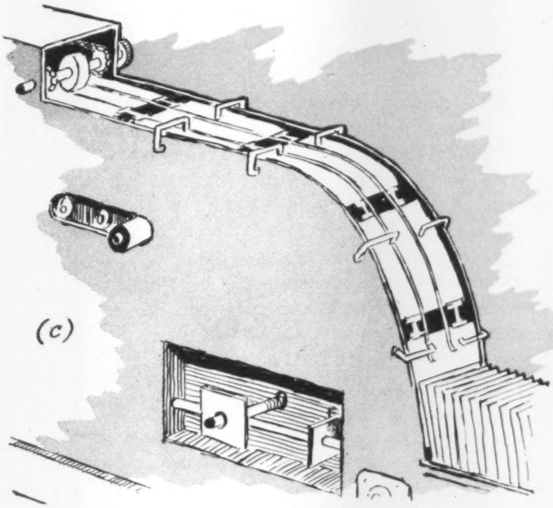


that all functional methods usually can be demonstrated, and functional risk eliminated, for a cost between 10 to 20 per cent of the total cost of a development program, and without materially increasing the total program cost. This means within $25,000 to $50,000 in the example.

Moreover, the most critical function can probably be proved out within the first $5000 to $10,000. This is a totally different burden on the progressive manager who must decide whether or not to proceed, than would be the case if the elimination of risk were not demonstrated until nearly $250,000 had been expended. Where new processes or new equipment include fairly high risk elements, it is a mighty comforting factor to know that the risk of basic inability to function has been eliminated when only such a small percentage of the cost has been risked.

There are few development engineers who can have their best ideas in their first approach to a problem. Thus, the engineers, as well as management, have a great deal to gain through the use of prove-out models to reduce their concepts to three-dimensional form. The very preparation of such a prove-out model will often cause modification, improvement, and simplification of their thinking. They have a chance to wrestle with the problems more extensively and much more intimately than if they were to go directly from concept to design. Advanced technical thinking must germinate by gradually bringing each facet of the picture into sharper focus. It is well to remember that the invention process does not happen all at once. Ideas develop and improve as the human mind works with them. Usually some of the first thoughts require some improvement. Such improvement is quite inexpensive during the thought crystallization stage, while the new process or method is proved out in a working model.

It is usually best to pick one or two of the most critical or challenging methods that are to be used in a new process or unit and prove them out first. With such questionable or challenging functions or operations proved, in their original form, or in a modified form that may be required, the remaining functions likewise can be proved out. If an operation should involve some unusual folding operations to a paper product, it probably would be worthwhile to demonstrate in a simple model the formation of each of the folds. If the process is a new method for assuring even plating of printed circuits with varying types of patterns, then the model should probably be used to demonstrate the evenness of the plating with each of a family of patterns that the production equipment must handle.


(c)

▶ Design for Production

The whole purpose of the prove-out model stage is to reduce the on-the-board design time to the provision of the proper force members, motion transfer members, support members, etc., and to remove from the decisions to be made during design, all questions with regard to what will happen in handling the product, or those regarding the feasibility of function concept.

After a method for each function has been soundly proved and demonstrated to the production people who will be responsible for its operation, these methods should then be designed into a production unit. This next step, designing equipment for production, is Step 3 in the step by step approach. Extreme care should be used to assure that, in carrying out the production considerations in the design of the production equipment, the basic, proved methods are not changed. A method may have been proved out on a straight-line reciprocating basis, but this does not mean that it cannot be translated into a rotary, continuous method if the critical functional aspects that were present are maintained. Each portion (or function) of the picture of the new machine should be brought into design focus as distinct functional entities with careful reference to the balance or interrelation of the functions. Keeping the functions separate during design usually has a tendency to simplify the resulting mechanisms. Such simplification is a great asset in construction, use, and maintenance.

▶ Build and Test

When each of the functions has been designed and the assembly drawings, and all of the detail drawings, have been prepared and carefully checked, etc., the whole job should not be put into the shop to be built at once. In proceeding to Step 4 and actual building, engineers must continue to be a bit humble and cautious. They must recognize that, in spite of the care taken, some mistakes may have crept in. There is nothing so rigid, and often so unadaptable as those intricately fabricated new members for a machine. The most critical part of the machine should be built and fully tested first. In fact it often is appropriate to let completion of design and detailing of some sections overlap (in time)

Step By Step Approach For Equipment Development

- Prepare general layouts of methods and processes.
- Prove out methods and processes in working models.
- Design equipment for production.
- Build and test production prototypes and/or units for critical functions.
- Build and test other units required.
- Assemble and test complete, integrated production system.

the building of the first sections.

If the final production equipment will consist of numerous duplicates of the same functional sections, then Step 4 should not be the building of the complete production unit. Rather it should be the fabrication and extensive testing of a complete production prototype, which will be incorporated into the final equipment. Often further simplification, opportunities for reduction of fabrication costs, and improved functionability can be seen and included as a result of this prototype step. If a prototype step is appropriate to the particular project, it is then followed by the full fabrication of the total production unit.

A word of caution is appropriate at this juncture —both for testing of final production units and testing of prototypes. If improvement opportunities are seen, it should not just be assumed that they will work—the step by step method should not be bypassed. Any change of method, that is basically different than the method initially proved, should be proved out in working models. This will again save time and money, and reduce the financial risk in attaining the advantages that are visualized in improvement opportunities that may occur. Also, the development engineer should not be berated for not having had all of the best possible ideas at the start of the project. Remember the germination process!

If the development project is to produce a single machine of its kind, then it is usually best to make only those post-design improvements which will be of very definite advantage or further reduce the cost of operations. Sometimes it is too easy to decide to make changes after sound equipment has been built.

After the principal function or functions have been constructed, tested, and improved (if applicable), the remaining portions of the equipment should be completed and progressively tested, Step 5. Then, Step 6, the total unit should be tested extensively. By this careful work, checking and testing through each of the steps, management and the engineer alike can be sure that when the new process or new production machinery reaches the production floor (or other end use), it will be ready to perform its duties and achieve the goals for which it was conceived.

On a project of significant scope, it is important to keep Steps 3, 4, and 5 flexible. It may be, for example, that the final transfer mechanism and/or operating and sensing controls should not be designed, or designs not frozen, until the prototype testing is underway. Considerable dollar savings can be accomplished by correctly perceiving when, in the timing of the total project, various designs and/or technical decisions should be frozen. Similarly, depending upon the project, various subaspects of a step may merit treatment as separate phases of the step by step approach.

▶ Consequences

Like all procedures involving human beings, the step by step approach will be as sound as the judgment of the people using it. But if clear analytical evaluation is used to judge that the prove-out models do prove all functional risk aspects, and do so under truly pertinent conditions, step by step automation will assure full success of automation programs—or determine infeasibility at a very low relative cost. In addition, the step by step procedure, through design, building, and testing, furnishes a careful check on the process of translating the proved methods into final production equipment.

When the step by step approach is followed through a project to completion, the project can go forward smoothly; many little, yet critical, aspects come into focus at the appropriate time; hundreds, or thousands, of decisions that must be correct come about and fit into place; the user's suggestions and the engineer's improvements can fit into play without costly revisions; and success is assured throughout the project. Thus, safety factors and soundness are provided in the step by step approach.

In all of this approach, there is a single focal point. The step by step approach is focused on the end result to be achieved. Whether the end result is to be a method of manufacturing, packaging, handling, controlling, or something else, it is the end result, and every premise concerning the end result, which is checked and rechecked with each step. And this care is not too expensive, for men can act decisively and efficiently when they are sure— sure of the newly invented processes or methods, and sure of success.

The economic consequences of following this procedure can have a dramatic influence on industry's ability to afford the risks which are present (whether recognized or not) in the development of new equipment. One of the greatest selling jobs to be done to persuade managements to actually take the progressive steps they wish to take, is to overcome their fears of huge sums to be spent without results. When risk exposure can be nearly concluded at $5000 to $10,000 instead of at $50,000 for a given project, or at $50,000 instead of $500,000 for a larger project, management can properly undertake more aggressively the risks inherent in the gains they seek. Thus, they can achieve those goals that are a *must* for success in the tomorrow of this technologically progressive age.

STACKING AND CASING WAX SLABS

MAJOR EMPHASIS in automating a production line is usually placed on improving and integrating primary manufacturing operations. Sometimes overlooked, or often relegated to minor consideration, is what happens to the product between those operations and the shipping dock. Quite often, major economies and increases in efficiency in this area can be obtained more readily than in the manufacturing area of the line since manufacturers of materials handling and packaging equipment have available many unique devices that can be integrated directly into the production line.

At Standard Oil of Ohio Refinery No. 2, the production of eleven-pound slabs of wax includes packaging and palletizing for storage or shipment. Wax slabs are conveyed from the manufacturing area of the line to an automatic case loader-sealer machine that performs every step from case setup to sealing without help from human hands. The packaging machine, including an automatic stacking device which receives single slabs and tiers them 5 high prior to insertion in the case, is a standard commercial unit that was built by J. L. Ferguson Co. for the wax slab industry. In co-operation with a paper converter, Hinde & Dauch, Div., West Virginia Pulp and Paper Co., who designed a special slotted corrugated shipper with exact dimensional tolerances to hold the slabs, the packaging machine manufacturer was able to furnish complete equipment to automate this operation with minimum engineering and development effort by Sohio engineers.

In operation, single slabs of wax are conveyed to the packaging machine feeder and automatically stacked on one another until a 5-high stack has been developed. In the meantime, a knocked down case feeds from a stack in a hopper and is formed and positioned on a case loader horn automatically, *Fig.* 1. The stacked wax slabs are then pushed endwise into the open end of the case, and the filled case is fed in a horizontal plane into a side gluer and side compression unit. After sealing, the case is discharged onto a gravity roller conveyor from which it is directly loaded onto a pallet for storage or shipment, *Fig.* 2.

Although the machine can be operated at a higher speed, it is currently set to pack about 195 pounds of wax per minute. The cases are precision-made to conform precisely to the machine's dimensional requirements. Such exact specifications insure steady production without delays from cases jamming the equipment. The automatic method of packaging assures gentle handling of the wax slabs from production to storage. It illustrates the ease with which commercially developed, "off-the-shelf" equipment items can be used to complement a production line with minimum development effort on the part of the user.

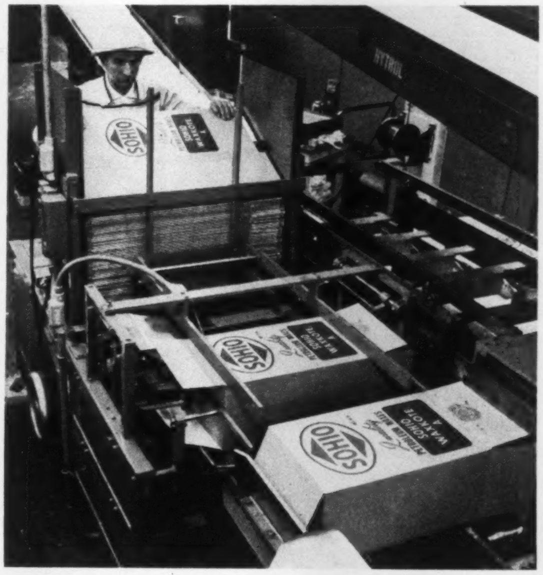


Fig. 1—Eleven-pound slabs of wax are conveyed single file from the manufacturing area to the packaging machine feeder on the right. After being stacked 5 high, the slabs are automatically end-loaded into formed case. The machine is currently packing about 195 pounds of wax per minute.

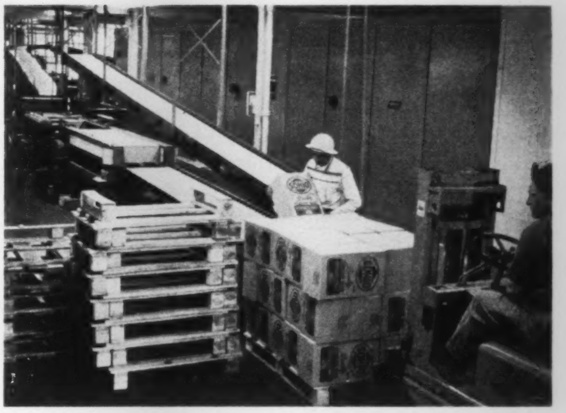
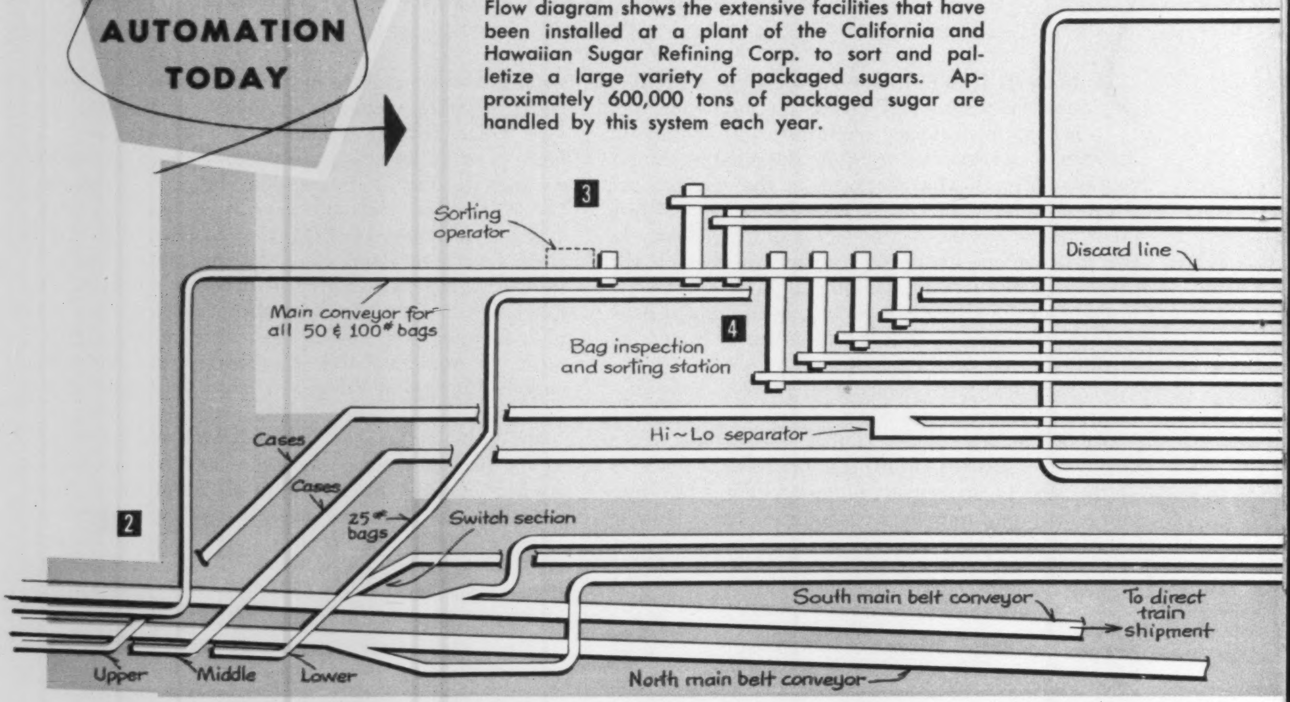


Fig. 2—At the end of the packaging line, an operator removes sealed cases from a gravity conveyor and stacks them on a pallet. The automatic packaging machine is a standard model that has been fitted with a feeder developed specifically for the wax slab industry.

AUTOMATION TODAY



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Flow diagram shows the extensive facilities that have been installed at a plant of the California and Hawaiian Sugar Refining Corp. to sort and palletize a large variety of packaged sugars. Approximately 600,000 tons of packaged sugar are handled by this system each year.

HANDLING PACKAGED SUGAR

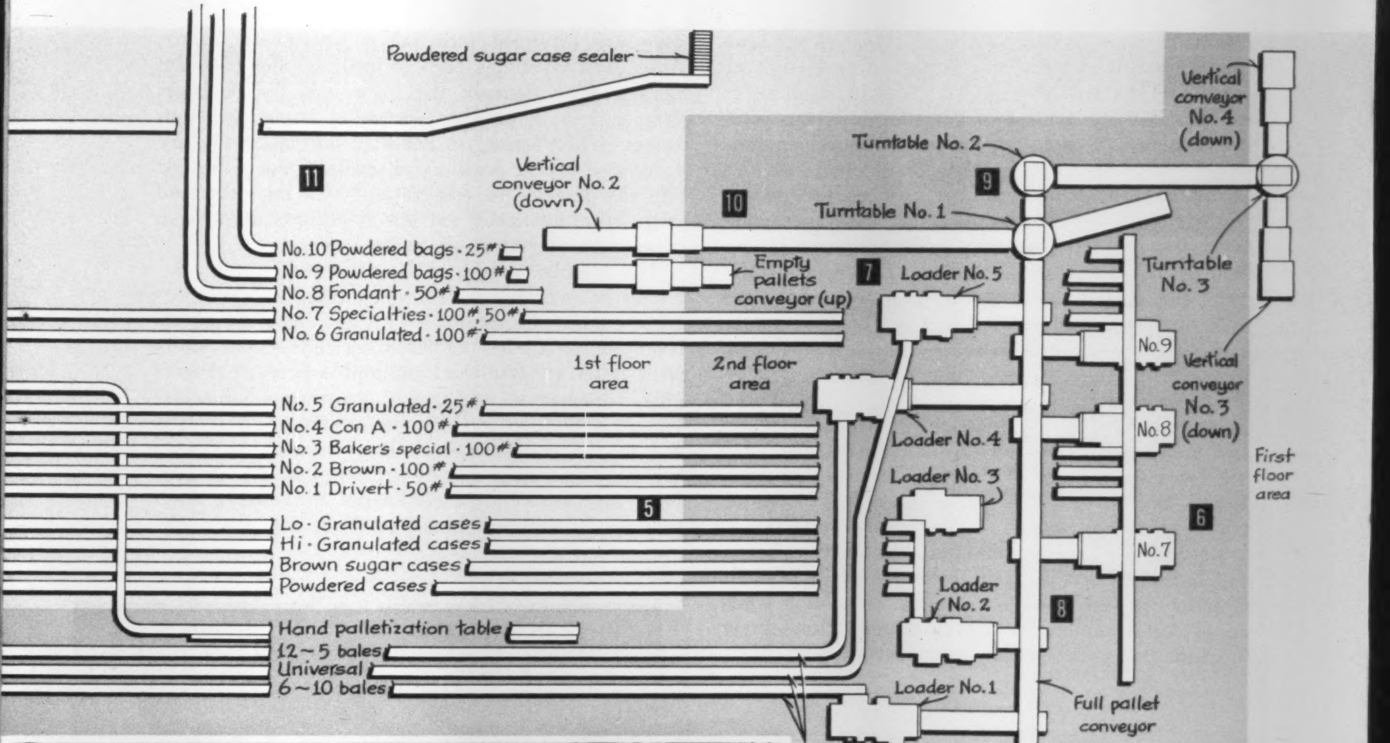
FROM REFINERY TO WAREHOUSE

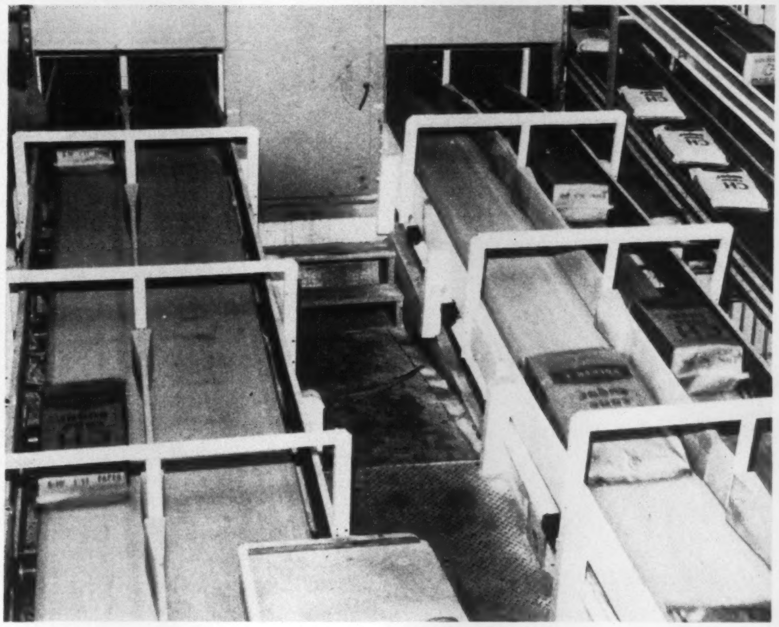
CANE SUGAR grown in Hawaii is used by 60 million people living in the western two-thirds of the United States, including Alaska and Hawaii. Most Hawaiian raw cane sugar is shipped by steamer to Crockett, Calif., where it is refined and packaged by the California and Hawaiian Sugar Refining Corp., a processing and marketing organization for all sugar producers of Hawaii.

At the present time, the yearly packaged output of this refinery is about 600,000 tons of sugar which includes granulated, powdered, brown, fondant, and many specialty types of sugars. Depending upon the intended use of the sugars, the various products are first placed in individual packages such as paper cartons, paper pockets, and cloth bags and then combined into suitable shipping containers. These shipping containers are divided into three general classifications: Shipping cases containing consumer cartons of various types of sugar; paper bales enclosing 6 to 30 paper pockets of granulated sugar; and bulk-packed sugar in 25, 50, and 100-pound paper bags.

The C and H Sugar Refining Corp. has invested $1.6 million in facilities for mechanized handling of shipping containers between the refinery packaging stations and the warehouse storage areas. In each 24-hour operating period, about 120,000 container units are transported and palletized by the extensive materials handling system. Included in the facilities are about 7300 feet of conveying equipment connecting the refinery in another building with the palletizing equipment in the warehouse; a sorting system employing static control for bulk-packaged sugar; eight mechanical pallet loaders which automatically stack the cases, bales, or bags into balanced, interlocked loads; and a pallet handling system that automatically dispatches loaded pallets to any one of four destinations for storage in the warehouse.

Shipping cases and paper bales are moved directly from the refinery packaging lines to accumulator conveyor lines preceding the automatic pallet loaders. Having a net weight of 24 to 60 pounds, the shipping cases are accumulated by type (powdered, brown, hi-granulated, or lo-granulated) on four lines of live-roll conveyors. As the lines fill up,


Powdered sugar case sealer
Vertical conveyor No. 4 (down)
Turntable No. 2
11
Vertical conveyor No. 2 (down)
10
9
Turntable No. 1
No. 10 Powdered bags · 25#
No. 9 Powdered bags · 100#
No. 8 Fondant · 50#
No. 7 Specialties · 100#, 50#
No. 6 Granulated · 100#
Empty pallets conveyor (up)
7
Loader No. 5
Turntable No. 3
No. 9
Vertical conveyor No. 3 (down)
1st floor area
2nd floor area
No. 5 Granulated · 25#
No. 4 Con A · 100#
No. 3 Baker's special · 100#
No. 2 Brown · 100#
No. 1 Drivert · 50#
Loader No. 4
No. 8
First floor area
Loader No. 3
5
6
Lo · Granulated cases
Hi · Granulated cases
Brown sugar cases
Powdered cases
No. 7
Loader No. 2
8
Hand palletization table
12 ~ 5 bales
Universal
6 ~ 10 bales
Loader No. 1
Full pallet conveyor
These three bale lines are actually located directly beneath the four case lines



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Belt conveyors, traveling at a speed of about 300 feet per minute, carry packaged sugar through an overhead viaduct which connects the refinery packing house with the warehouse. Hardwood divider strips were installed over two existing belts to provide four operational lines to handle bagged and baled sugar. A tiered system of three conveyors, far right, was installed to move 25-pound bags and cases.

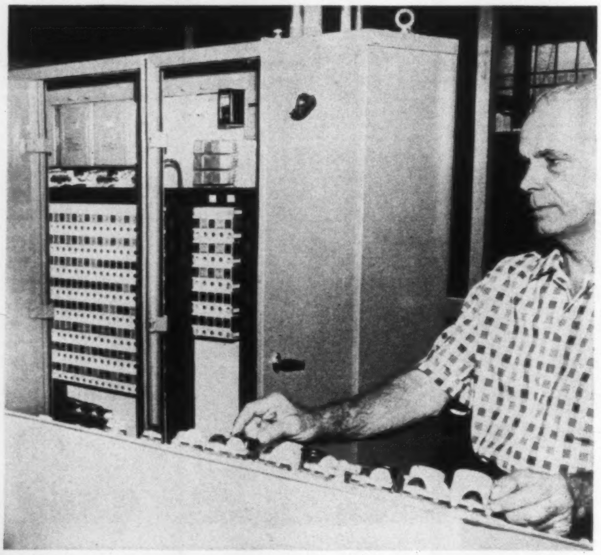
the cases are directed automatically into either or both of two pallet loaders. Successive layers of interlocked cases are built into pallet loads, according to a preset pattern for each size case. Palletizing rates vary from 30 to 35 cases per minute, depending upon case sizes and pallet patterns.

Paper bales, weighing 60 pounds, contain twelve 5-pound or six 10-pound units of granulated sugar. The bales are accumulated on three conveyor lines located directly below the four case lines. Each bale accumulator line feeds to a separate pallet loader. Two loaders are in constant use while the third unit is maintained for standby purposes and for palletizing odd bale lots such as thirty 2-pound units or six 10-pound cloth bags. The bales are automatically loaded on pallets at a rate of about 25 bales per minute.

The system for palletizing paper bags is more complex since at least ten different sugar types or bag weights must be handled. The majority of the 50 and 100-pound bags are transported from the refinery building to the warehouse building on a common conveyor line and are then sorted and routed to six accumulator lines, according to type of sugar and weight of bag. The sorting mechanism is controlled by a General Electric Co. static control system. As each bag passes a sorting station, an operator enters the identity of the bag into the control system. When the bag reaches the proper transfer point, it is shuttled from the main conveyor to one of the six accumulator lines. Bags are held on the accumulator lines until there are sufficient quantities to form pallet loads. The bags are then directed automatically into one of three pallet loaders previously designated to handle a particular bag size or sugar type. Four other accumulator lines also feed into these three pallet loaders. These lines run directly from refinery packing stations and include two lines for 25-pound bags. Palletizing rates vary from 20 bags per minute for 100-pound bags to 30 bags per minute for 25-pound units.

The eight pallet loaders were specially designed and built by Lamson Corp. to handle 44 by 60-inch C and H pallets which are capable of holding loads up to 4500 pounds. As packaged items flow single file into the pallet loaders from accumulator lines, they are arranged into preset interlocked layers. After each layer has been formed, a roller platform retracts from beneath the layer and the packages drop a few inches onto a pallet supported from below. This action is repeated automatically for successive layers until a full pallet load is formed and discharged. An empty pallet for the next load is then automatically fed into loading position from a storage magazine on the pallet loader.

The complex nature of the materials handling facilities has required increases in mechanical and electrical maintenance work. This has been offset by handling economies achieved by the system along with other tangible and intangible benefits. Previously, damage to packaged sugar during hand palletization resulted in costly rehandling and increased container costs. These costs have been reduced considerably by mechanical palletization. More uniform and better balanced pallet loads have been achieved, permitting better stacking and more effi-



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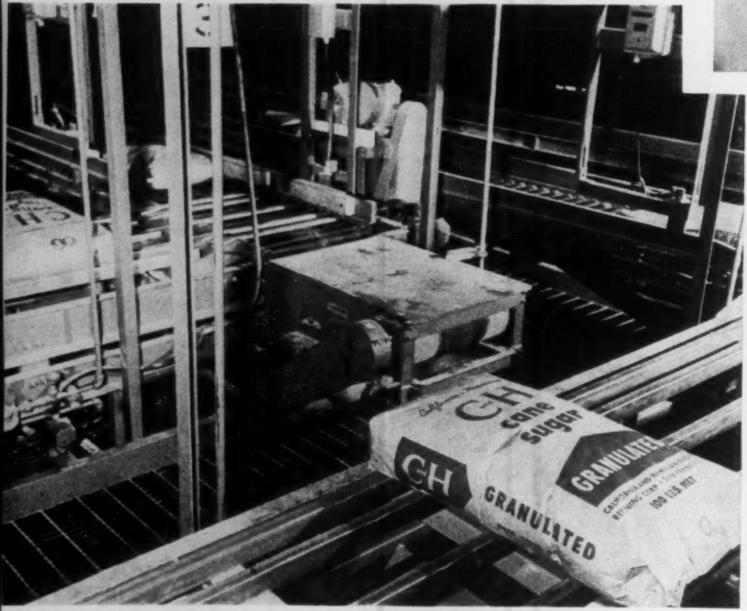
From the viaduct, 50 and 100-pound bags travel over a common conveyor belt to a sorting station located on an upper story of the warehouse. An operator identifies each unit as it passes the station and presses a button designating one of six transfer points for removing the particular bag from the main conveyor to an accumulator conveyor. The General Electric Co. static control system, left background, actuates the designated transfer mechanism at the proper moment to automatically shuttle the bag from the main conveyor.

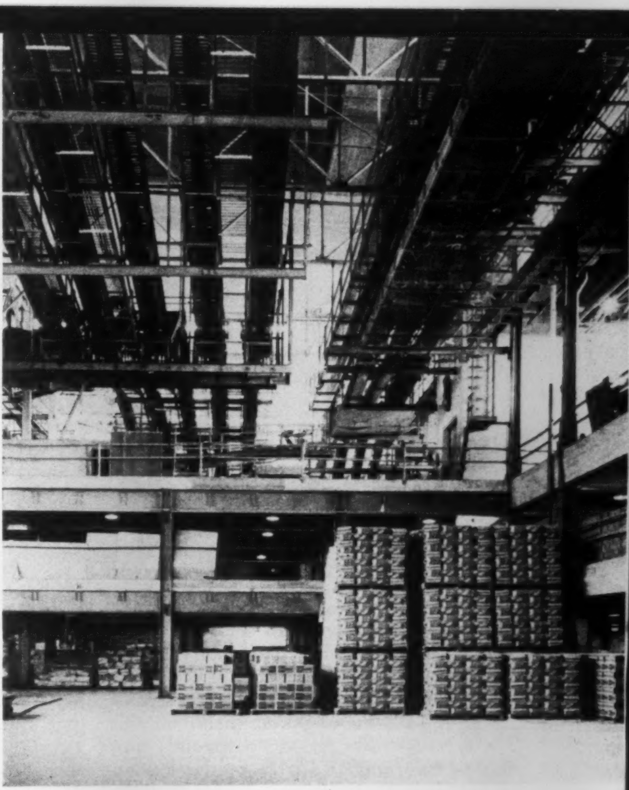


4

This view shows 100-pound bags on a transfer conveyor connecting the main conveyor to the accumulator conveyors. The accumulator lines run from right to left in the background, and the main conveyor runs parallel to the accumulator lines, out of the picture to the left. As a bag reaches the proper transfer point on the main conveyor, an air cylinder is energized by the static control system. This cylinder lifts moving V-belts between rollers on the main conveyor which convey the bag at right angles from the main conveyor to the proper accumulator line.

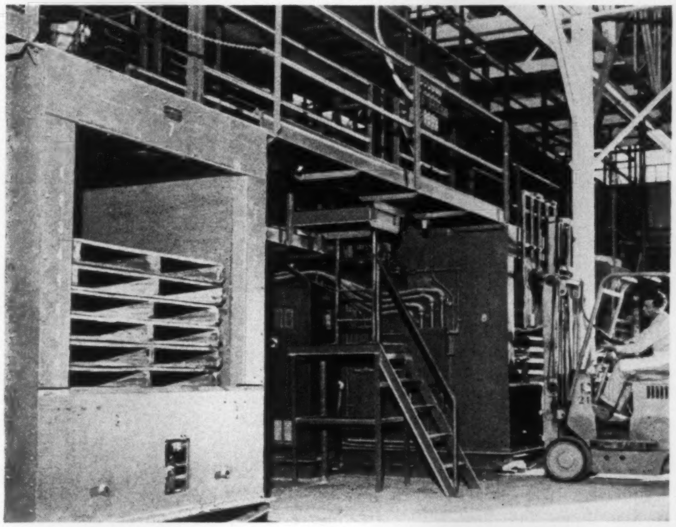
cient storage in the warehouse. Easier and more flexible production scheduling has also resulted from the new system. Mechanical devices have been substituted for heavy manual labor, increasing the safety of the workers and improving employee relations.

The accompanying illustrations highlight the degree of mechanical handling that has been incorporated in this high-volume installation.



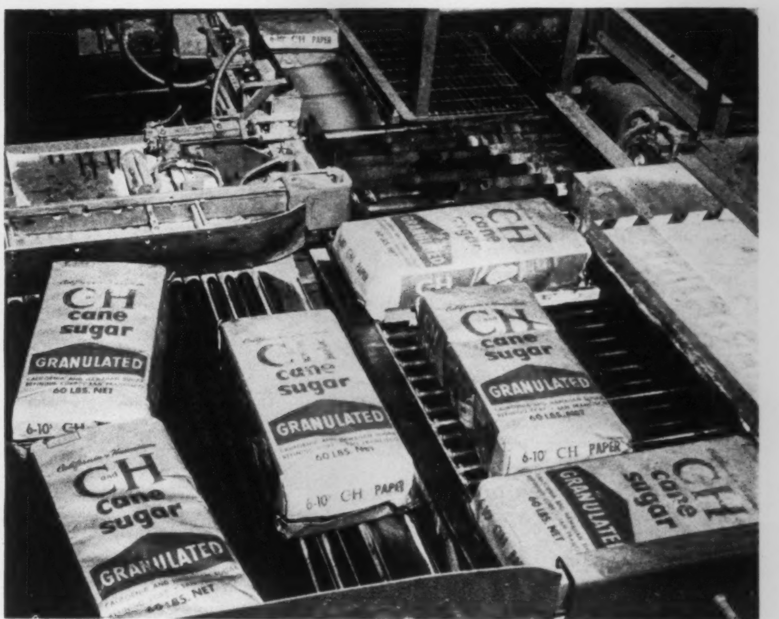
5

From the sorting station the accumulator lines move packaged sugar to the palletizing stations located on an upper floor of the warehouse. The accumulator lines are suspended from roof trusses approximately 40 feet above the first floor storage areas, making use of what was previously waste space. Five of the ten bag accumulator lines are shown at the upper left. At the upper right are multiple level accumulator lines in which four case lines run above three bale lines.



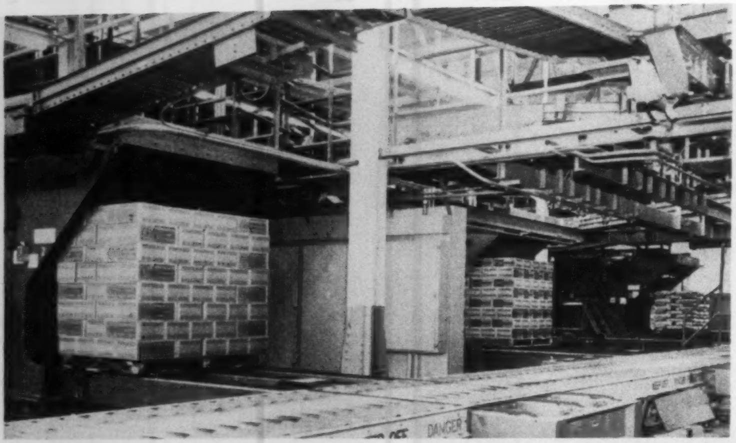
6

The seventeen overhead accumulator lines feed cases, bales, and bags to eight pallet loaders located on an upper floor of the warehouse. This view shows the rear of three of the pallet loaders where empty pallets are loaded into a storage magazine. Each magazine holds eight pallets which is sufficient for 15 to 30 minutes of normal operations. Five of the pallet loaders handle bales and cases while the remaining three units palletize bags.



7

Top view shows one of the eight pallet loaders. Bales, containing six 10-pound pockets, are conveyed from the accumulator line, top center, to a turning device which rotates some of the bales to form an interlocking pattern. The oriented bales then ride against automatic spacing stops which thrust up between rolls. A ram, right, moves forward and pushes the oriented and spaced bales onto a roller platform, left. As the platform is withdrawn from beneath the bales, an interlocking layer is dropped onto a pallet below.

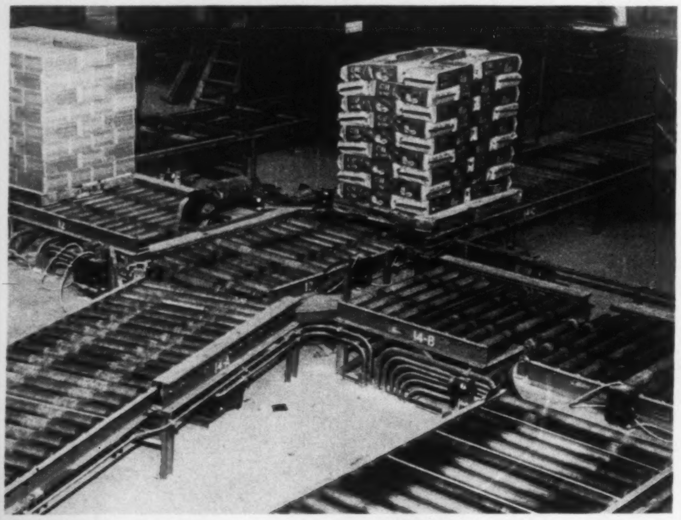


8

Three pallet loaders are shown discharging, from left to right, cases of powdered sugar, cases of granulated sugar, and bales of granulated sugar. The pallet conveyor in the foreground receives the loaded pallets and, through a switching system, carries the pallets to one of three automatic elevators which lower the loads to the first floor.

9

Loaded pallets from all pallet loaders, upper left, are conveyed to a switching system which shuttles the load to the proper automatic elevator. The first turntable can switch the load to an elevator or to a fork truck pick-up point on this same floor. Alternately, a second turntable, lower right, can route the loaded pallets to either of two other automatic elevators leading to first floor storage. An operator can select any one of the four final destinations by presetting a switch at each pallet loader.

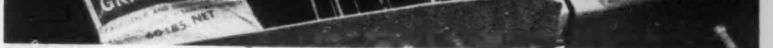


10

Automatic elevators serve the upper floor palletization facilities. The left elevator brings stacks of empty pallets from the first floor warehouse, and the right elevator lowers loaded pallets to storage and shipping areas. Two other elevators are used to serve other floor storage areas. Each elevator operates at a rate up to one round trip per minute and has a capacity in excess of 4500 pounds.

11

Final operation is the moving of loaded pallets from the automatic elevators to storage. Fork trucks stack the balanced loads as much as four high. The mechanized palletization system has resulted in more uniform and better balanced loads which permit better stacking and more efficient use of storage space.



IMPROVING MACHINE DEPENDABILITY

A DESIGN RESPONSIBILITY

Efficiency of an automatic production machine is determined primarily in the blueprint stage. Machine design groups, therefore, are properly charged with responsibility for control of downtime causes and adoption of techniques that permit quick restoration of service when downtime does occur.

By **DAVID I. DUMOND**
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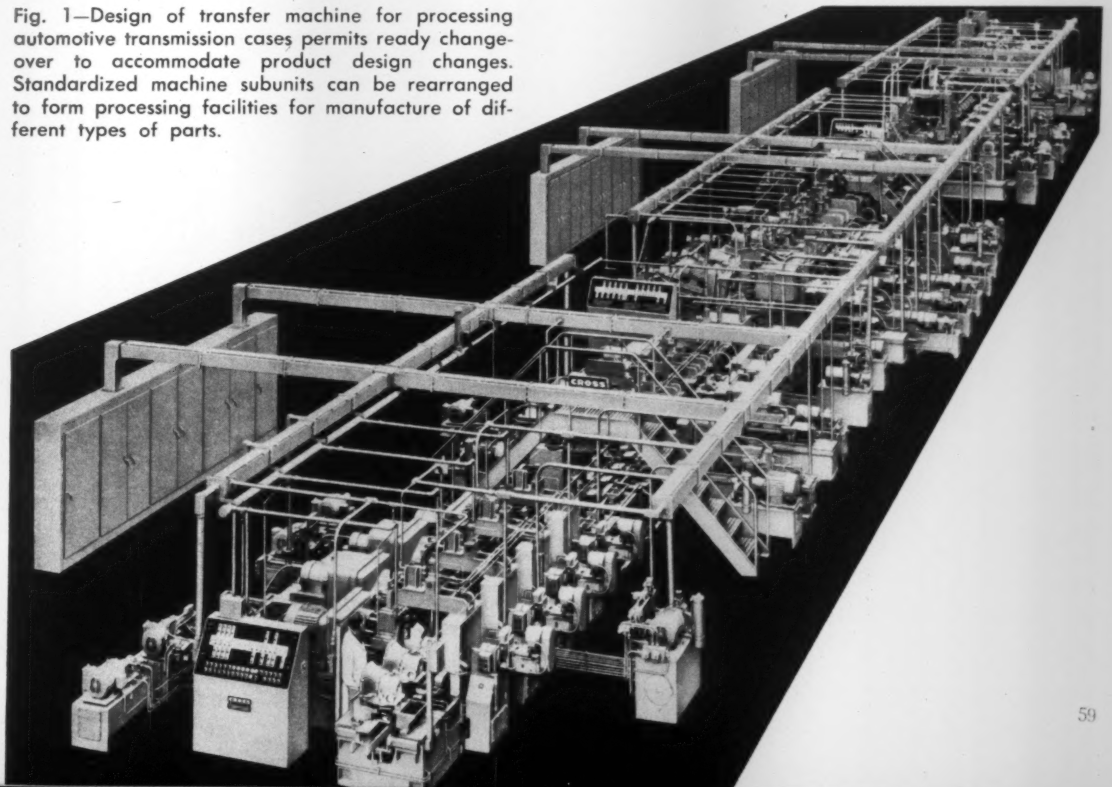
TODAY, more than ever, manufacturers and machine builders are pressing for ways and means of increasing the practical limits of production machine efficiency. Since machine efficiency is affected adversely by downtime, efforts are logically being directed to reducing this factor to a minimum level.

It is now realized that the efficiency of an automatic machine tool is determined largely by its design. Future improvements, therefore, will depend strongly upon how successfully designers prevent or minimize the causes of downtime and develop efficient methods for restoring machine operation when downtimes do occur.

By placing the lion's share of responsibility for solution of the downtime problem where it belongs—in the hands of the machine design group—builders are getting to the root of the trouble. In most cases, strategies for reducing machine downtime find concrete expression as design features or affect the design function in some other way. Also, by centralizing responsibility in this group, clear communication channels are opened for transmission of suggestions from other sources—research and development engineers, service engineers, and production and maintenance personnel.

Continuous operation of production equipment at 100 per cent efficiency is neither possible nor prac-

Fig. 1—Design of transfer machine for processing automotive transmission cases permits ready changeover to accommodate product design changes. Standardized machine subunits can be rearranged to form processing facilities for manufacture of different types of parts.



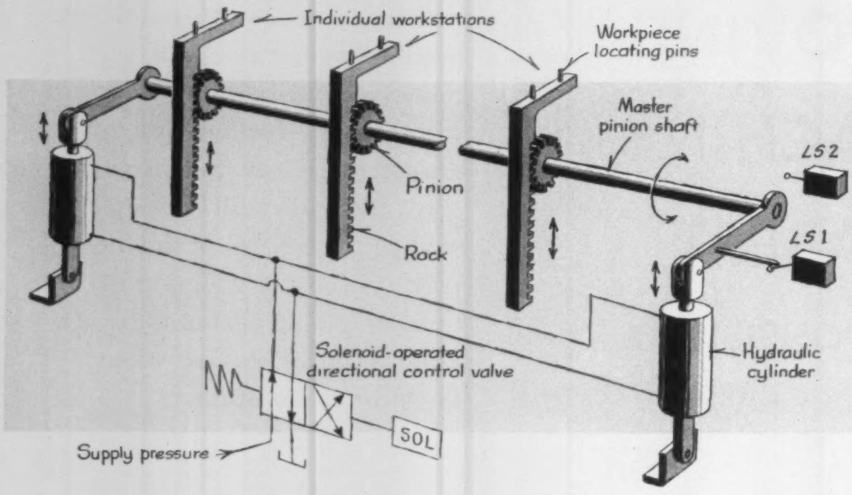


Fig. 2—Diagram illustrates simplified design of mechanism to raise and lower locating pins that engage holes in workpieces during machining cycle. Previous design required a hydraulic cylinder, a control valve, and two limit switches at each workstation.

tical. Therefore, a more realistic machine performance goal is sought: Maximum dependability of a machine during periods it is required to function to meet production demands. Always a problem, control of downtime is complicated, and becomes even more vital when machine units are combined into systems that perform multiple operations simultaneously, *Fig.* 1. The rising trend toward this type of arrangement—exemplified by the increasing popularity of transfer-type machines in industry—promises to continue.

▶ Controlling Downtime

An obvious way of improving a machine's dependability is to prevent the occurrence of downtime in the first place. Implementation of this simple concept, however, is limited by functional requirements and requires constant design effort and review. Nevertheless, some highly effective results can often be obtained by "weeding out" unnecessary frills and components that fail frequently or require excessive servicing. In general, a machine that performs its functions with a minimum of mechanical, electrical, hydraulic, and pneumatic components will be more dependable than one that requires many of these elements.

Design simplification applied to the workpiece locating mechanism for a multistation machine tool illustrates an application of the "weeding out" process. In the arrangement shown in *Fig.* 2, a master pinion shaft is activated by hydraulic cylinders at its ends to provide the drive for a series of racks. There is one rack at each machine station. When the cylinders are actuated, the racks are raised and lowered together so that locating pins in the ends of the racks can engage and disengage register holes in workpieces. Two limit switches control the action of a solenoid operated directional control valve to effect raising and lowering of the cylinders.

In former designs of locating mechanisms, an individual drive and control system—including a cylinder, pinion, rack, control valve, and two limit switches—was used at each machine station. Thus, in a 30-station machine, 30 hydraulic cylinders, 30 control valves, and 60 limit switches were required. In contrast, the design of *Fig.* 2 requires only two cylinders, one control valve, and two limit switches for the same type of machine. The result of design simplification was improved dependability, easier assembly, less maintenance, and reduced machine cost.

Where components cannot be eliminated through design simplification, notable improvements in machine dependability can often be secured through use of high quality, reliable components. Naturally, a machine system can have no more dependability than that of its components, and efforts directed to improving these elements are often effective in minimizing some of the causes of downtime. Where components are purchased, specification of tried and proved items is usually the safest course.

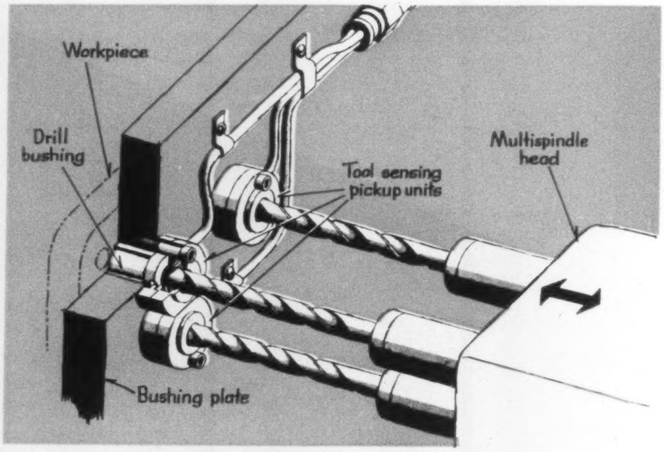


Fig. 3—Downtime and production of defective parts are reduced by providing work spindles with pickup units that electronically sense presence or absence of tools. Broken or missing tools are detected and the machine shut down until they are replaced.

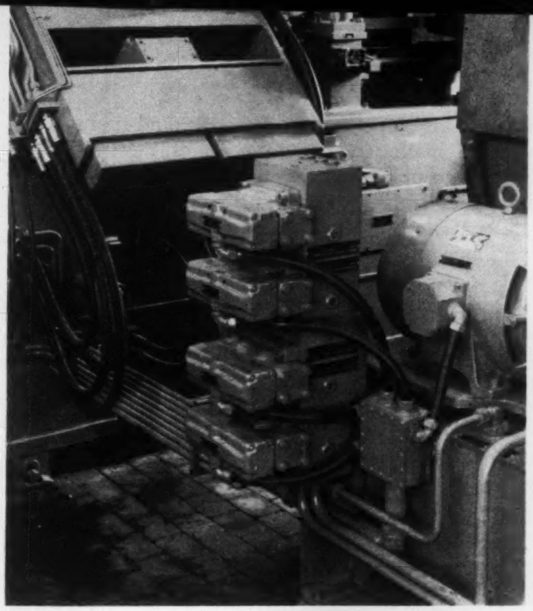


Fig. 4—Mounting of electrohydraulic control valves on auxiliary power unit instead of main machine protects these components from exposure to chips, dirt, and oil in work areas. Accessibility for servicing is also improved.

Adoption of proved research developments that provide more reliable means of performing or controlling machine functions is another way of upgrading a machine's dependability. One such development—static control—is finding wide application in the control of complex, automatic machine tools. Static controls function without any moving parts, and hence have theoretically unlimited life. While they cost more than conventional relays, users are willing to pay a premium to obtain their potential for less downtime due to electrical failures.

Another example of a research development that has proved applicable in reducing machine tool downtime is the electronic proximity switch. One form of this device employs a pickup unit that senses the presence or absence of metals. When applied to the detection of broken or missing tools, *Fig.* 3, the pickup unit senses the absence of metal and signals a control panel that shuts down the machine until the condition is corrected. In this way, one of the most frequent and costly problems with existing transfer machines—tool failure that goes undetected because parts progress through several machining stations before reaching an inspection head—can be solved. The consequences of tool breakage—production of defective parts and possible additional tool damage as bad parts progress through the machine—are thus avoided. When used throughout a line on long, small-diameter tools, these detectors can eliminate the need for separate probe and inspection stations and reduce the over-all length and cost of a machine.

The environment in which components are expected to function deserves consideration. Often, good design practice can alleviate trouble from this source. In the location of limit switches, for example, every effort should be made to physically isolate the switches from the work areas of the machine where they might be subject to damage from chips, dirt, and coolant. Use of separate switch actuating members such as shafts and levers or cams is one way of accomplishing this isolation. In cases where such means cannot be employed, and the switches must be in the work area, permanent shields can be effective. The direction of mounting of the switches can also provide some protection.

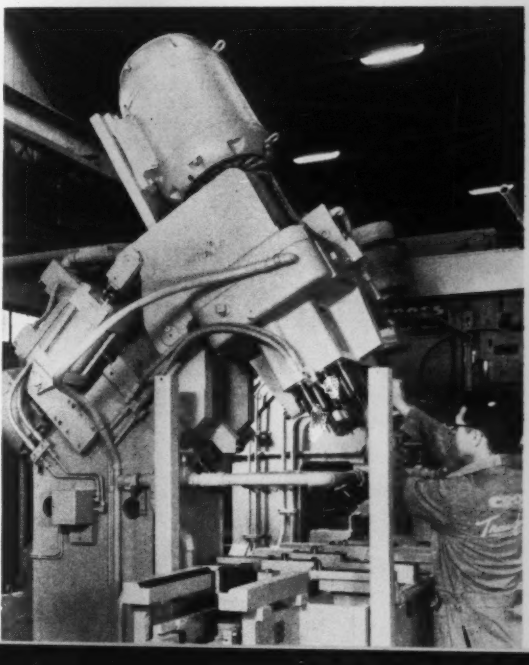
Valve mountings are another example of component location so as to protect against excessive dirt and oil. Modern design practice calls for mounting these components away from the machine proper, *Fig.* 4, usually on separate hydraulic power units.

▶ Expediting Maintenance

Prevention of downtime solves only half the problem. Equally important are methods and design features that expedite maintenance work when a machine must be shut down for predictable or unpredictable reasons. One of the methods that can be employed to reduce maintenance time is the so-called "buddy" system of programmed tool and machine maintenance. In this procedure, machine servicing is performed simultaneously with shutdown for tool replacement. Downtime is governed by the item or items requiring the longest service time.

In spite of the many advancements being made in extending the life of cutting tools, it has not been possible to eliminate the need for tool replacement. By providing access to tool spindles, *Fig.* 5, and specifying preset-type tooling that can be

Fig. 5—Machine downtime for tool replacement is minimized by swivel mounting of multispindle work head. When tool replacement is completed, head is returned to vertical operating position.



set to gage dimensions outside the machine, designers can expedite tool changes.

Certain machine and control elements—including locating pins and pads, oil seals, hydraulic cylinder packings, solenoids, relays, and limit switches—also require periodic replacement. Designers should constantly review these items for simplicity and interchangeability, which are prerequisite to fast, simple servicing. Naturally, those items that have the highest replacement rates, and contribute most to machine downtime, should receive the greatest attention.

Locating pins and pads require frequent replacement because the accuracy with which they locate workpieces directly affects product quality. Quick replacement of these items is facilitated by designing them to be as simple as possible and manufacturing them to tolerances that permit interchangeability.

Where possible, oil seals should be eliminated by the use of labyrinth construction or by substituting mist for direct lubrication of a work head. Where oil seals must be used, the mechanical design should permit ready replacement without major disassembly. In Cross Co. machines, for example, an oil seal may be replaced by removing only three bolts and a seal retainer.

Replacement of hydraulic cylinders used for clamping and transferring workpieces, and traversing heads, can be facilitated by locating these cylinders on the outside of the machine where possible. In some designs, cylinders can be removed and replaced without disturbing any piping or disconnecting piston rods from the mechanisms they actuate.

Solenoids can be mounted in oil-tight compartments and quickly replaced by removing gasketed covers and mounting screws. When the solenoids are separated from the actuated members (such as control valves) by intermediate actuating pins, the solenoids may be lifted out for servicing without disturbing the actuated components.

Design of control panels can contribute to a machine's dependability, to the extent that troubleshooting is facilitated when the panels include indicators to pinpoint the locations and natures of machine malfunctions. On complex machines, additional troubleshooting time may be saved when the panel is laid out in the form of a graphical representation of the machine, with signal lights positioned on the panel in the same relative locations as the machine elements controlled.

Another troubleshooting aid is to provide separate panels for different types of controls. For example, grouping 440v power circuits in one panel, interlocks in another, and workhead control relays in a third is a popular arrangement that simplifies troubleshooting and correction of a particular type of fault.

▶ Importance of Flexibility

Not to be overlooked are problems associated with model or part design changes. The cost and time required to convert a machine for changed or new part processing is one of industry's most pressing problems. For this reason, designers must continue to strive for greater flexibility of machine components and subunits through maximum standardization in design, dimensions, and tolerances.

Standardized modules that facilitate machine conversion at low cost and time include feed units, wing bases, columns, center base sections, and transfer mechanisms. Properly developed, these modules should have standard hole and keyway patterns for mounting to the machine base. This will permit units to be shifted from station to station in a minimum amount of time and with complete accuracy, *Fig.* 6. With techniques such as these, users are finding the cost of converting transfer machines to facilitate processing of modified or new parts is only a fraction of original capital investment.

In the final analysis, designs which achieve optimum simplicity and interchangeability have always given the most trouble-free service. In pursuing specific problems affecting downtime, designers must continue to strive for these features. Most of the limitations likely to be encountered in preventing downtime are those imposed by the designer's own imagination.

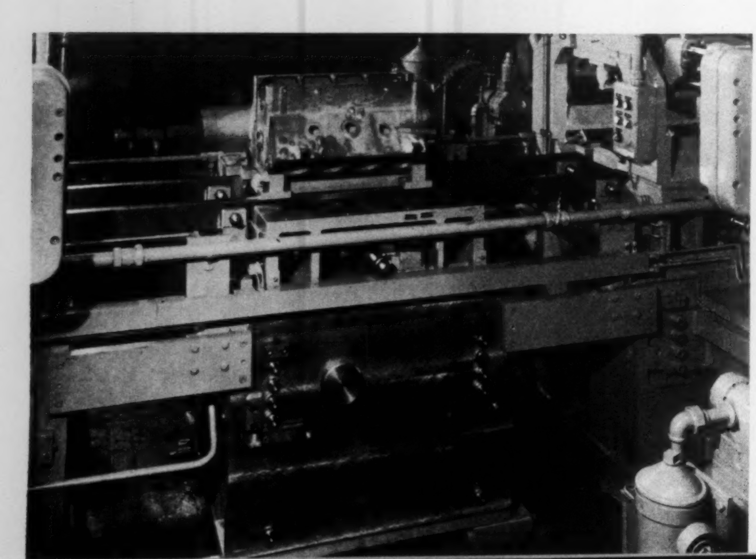


Fig. 6—Close-up of mounting plate at idle station in transfer machine illustrates standardized bolt hole pattern and locating block arrangement used. Any of several types of machine units may be coupled to mounting plate to form a workstation.

SYSTEM ROUTES CARTONS TO MULTIPLE ZONES

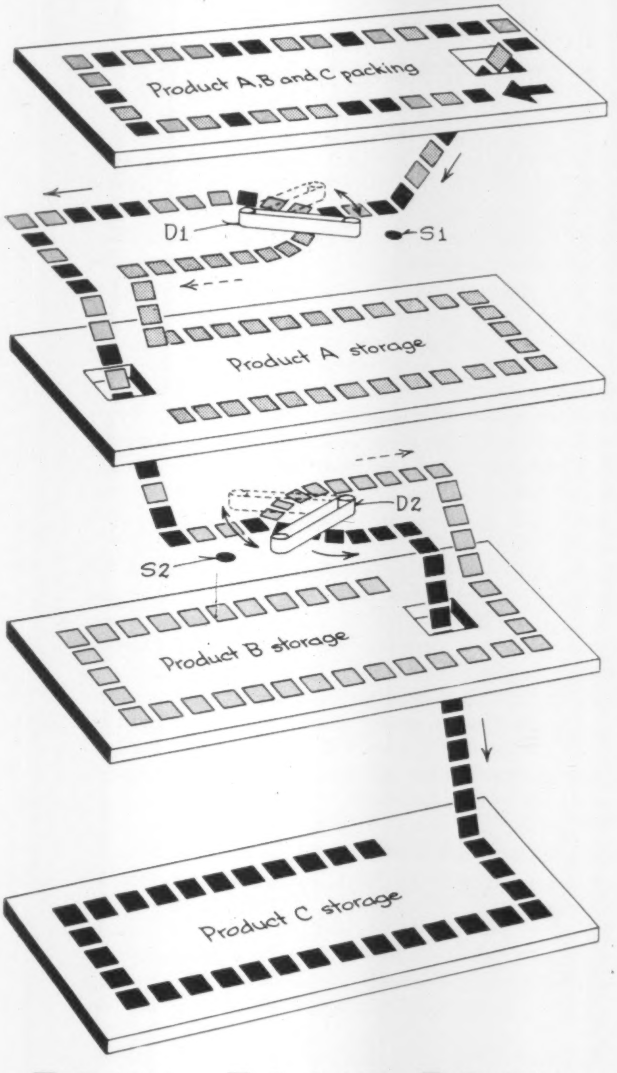

Product A,B and C packing
D1
S1
Product A storage
D2
S2
Product B storage
Product C storage
▨ - Product A ☐ - Product B ■ - Product C
S1, S2 - Photoelectric scanners D1, D2 - Mechanical diverters

Fig. 1—Schematic flow diagram illustrates paths of travel for three types of products packed in cartons on fourth floor of multistory plant. Photoelectric scanners *S1* and *S2* inspect code markings on cartons as they pass on conveyor line and actuate mechanical diverters *D1* and *D2* to route cartons to storage on proper floors.

ONE OF the last handling functions to be performed in most manufacturing processes is the conveying of finished, packaged goods to storage. Usually, this operation involves multiple routing, since order filling, shipping, and inventory taking can be greatly facilitated when products are segregated by types and stored in separate locations.

Management at Chicago Printed String Co., Chicago, Ill., realized the benefits that would accrue if cartons of each of three different types of brightly colored ribbon they produce could be routed smoothly from a common packing area to separate storage areas. The top floor of their four-story building is used for packing of all ribbons, and each of the lower floors is allocated to receive packed cartons of a separate ribbon product.

▶ Selecting A System

As a first step in planning a handling system, three proposals were considered. In one method, cartons would travel single-file along a conveyor line running down through the building. Inspector-handlers, in constant attendance at the third and second floors, would spot and manually remove the cartons containing the products for those floors. Product for first-floor storage would be allowed to proceed on the conveyor.

In a second proposal, a separate conveyor line would be provided for each floor. Each of the three different types of product would then be placed on its assigned conveyor line at the fourth-floor packing area and routed directly to the appropriate floor for storage.

Both of these methods would have been more expensive than the third proposal, which was adopted. The automatic system provided, *Fig.* 1, was designed and built by Alvey Conveyor Mfg. Co., St. Louis, Mo. It employs a single main conveyor, consisting of gravity and powered sections, that originates in the fourth-floor packing area and threads through the building from story to story. Spur lines connect to this conveyor on the third and second floors. An electronic scanning device just ahead of each spur line identifies the cartons passing by on the main conveyor. Depending upon whether or not a carton is destined for storage on that floor, the scanning device will signal a mechanical diverter to route the carton onto the spur line or let it pass.

System Operation

In operation, all three types of ribbon are packed simultaneously in the packing area. Packed cartons are deposited—in more or less random quantities and order—on the common main conveyor in this area. They then proceed in single file and are lowered by the conveyor through an opening in the fourth floor. After this, they are directed horizontally on a conveyor section suspended just below ceiling level of the third floor storage area.

As the cartons containing various types of product proceed along the third-floor ceiling area, they arrive in turn at a short belt section in the main conveyor. Each leading carton in succession is picked up by this belt section, accelerated to 125 feet per minute, and moved past a photoelectric scanning device, *Fig.* 2. This device, placed near the end of the belt section, "reads" code markings on each carton. The leading edge of each carton activates the device.

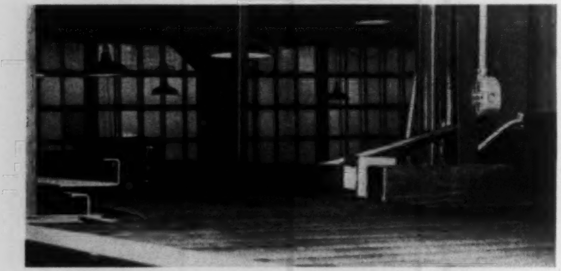


Fig. 2—Photoelectric scanner, center foreground, inspects code markings on cartons as they are delivered on belt. Leading edges of cartons trigger device, which generates electrical signals that determine routings of cartons.

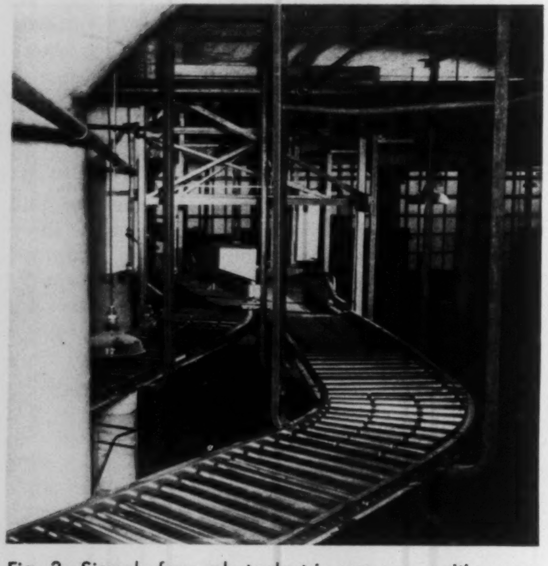


Fig. 3—Signals from photoelectric scanner position mechanical diverter, center, to route cartons that have proper code marking to storage via spur line, left. Cartons containing other codes are allowed to pass on main conveyor line, right, as shown.

A separate code is used for the cartons for each type of ribbon. The codes consist of arrangements of black 1-inch squares that are printed on the cartons near their leading edges and bottoms, away from the artwork and labeling areas. Although confined to a 4 by 6-inch area on the carton, patterns of squares can be varied to establish up to 256 distinct codes. At present, only three are required.

Automatic Routing

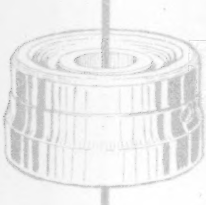
When a given code is read by the scanner, one of two types of actions will result: 1. If the code is that for a carton that is destined for the second or first floors, the scanner control will sense whether or not a mechanical diverter, *Fig.* 3, is in position across the main conveyor line. If the diverter is in this position, the belt will stop and the diverter will be moved out of the way by a pneumatic actuator. The belt is then restarted and the carton is deposited on a powered roller section of the main conveyor that carries the carton away. When the diverter is found properly positioned, the carton proceeds on to the main conveyor without stopping. 2. If the code is for a product for third-floor storage, the diverter position is sensed (and corrected if necessary) so that the carton will pass onto the spur line.

In this manner, all of the cartons destined for storage on the third floor are diverted from the main conveyor line by the scanner. Cartons which have not been diverted are led to a belt section on the second floor where they are subjected to a similar inspection and automatic routing procedure. These cartons are automatically diverted to second-floor storage via a spur line or are passed to first-floor storage on the main conveyor line, depending upon their code markings.

Cartons are removed from the storage lines on each floor by a stock man. Because total production in this plant averages about two cartons per minute, this operation is performed only at infrequent intervals.

The electrical controls that govern the conveying, scanning, and diverting functions of the handling system employ plug-in circuits where possible. Relays are the hermetically sealed, plug-in type. Accessibility to the components was a primary concern in the design of the controls, in order to facilitate maintenance and troubleshooting.

The automatic routing system described was tailored for installation in an existing, multistory plant. However, its principle of operation is applicable wherever a need exists for automatic sorting and dispatching of different products or materials to different locations.



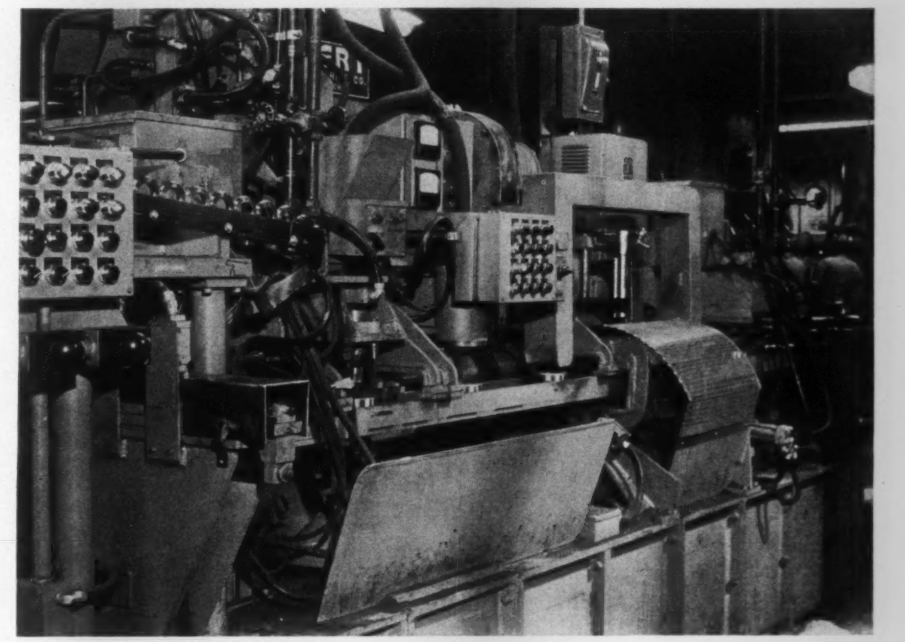


Fig. 1—Parts for torque converter transmissions are processed on this 10-station automatic shielded-metal-arc welding machine built by Expert Welding Machine Co. Inc. for the Buick Motor Div., General Motors Corp. In addition to arc welding a hub ring to a drum stamping, the machine automatically presses the parts together and preheats them prior to welding, removes unused flux from the weld, cools and jars the weldment to clean the fillet weld, and finally reheats the assembly to relieve stresses.

TRANSFER WELDING MACHINE

INTEGRATES ASSEMBLY AND STRESS RELIEVING

OVER THE YEARS welding has played a large part in the development of new and better products which can be manufactured by automatic means with substantial increases in production output and reductions in unit costs. This is particularly evident in the automotive industry which uses all types of welding processes in the manufacture of automobiles and trucks. Along with the development of better welding equipment and high strength metals possessing good welding characteristics, the automotive industry has led in the development of automatic machinery that increases welding speeds, produces uniform quality in welds, and relieves operators of tedious work.

One welding process that has gained many applications in the automotive industry in recent years is shielded-metal-arc welding. At the Buick Motor Div., General Motors Corp., this method of welding is used in the production of torque converter transmissions. In co-operation with manufacturers of arc welding equipment, Buick engineers have developed a new machine which not only produces arc welds automatically, but also is self-loading and unloading and performs several supplementary operations. In addition, the automatic welding machine is a part of a mechanized line that performs machine work on the torque converter parts both before and after passing through the welding machine.

▶ Operations Performed by Machine

The automatic shielded-metal-arc welding machine, *Fig.* 1, was built by the Expert Welding Machine Co. Inc., a division of Expert Die & Tool Co. Inc. It is used to make a circular arc weld joining

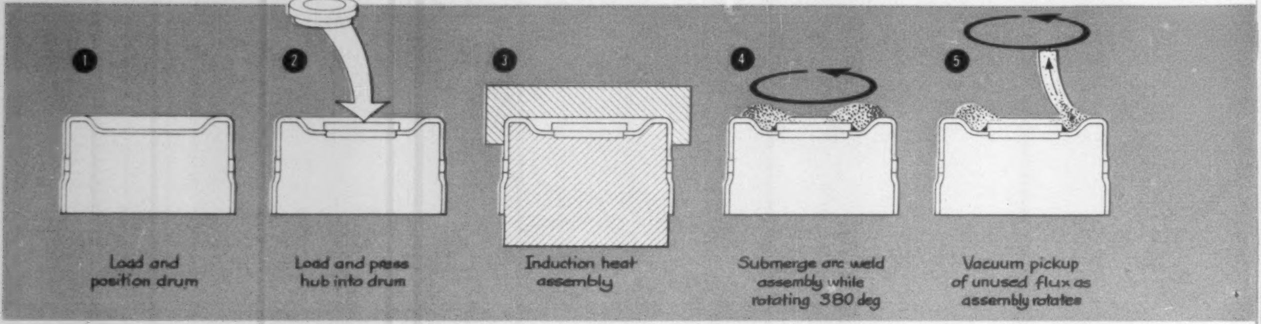

1
2
3
4
5
Load and position drum
Load and press hub into drum
Induction heat assembly
Submerge arc weld assembly while rotating 380 deg
Vacuum pickup of unused flux as assembly rotates

Fig. 2—Flow diagram shows the operations performed at each of the ten stations. Assemblies are transferred between stations by a reciprocating transfer bar which rotates lever arms into contact with the parts, advances the parts, and rotates the lever arms out of engagement for the return stroke.

two components of a torque converter transmission part called a front planet ring gear carrier assembly. One component is an SAE 1041 steel hub ring that is pressed into a central hole in the recessed head of the other component, a drum-like drawn stamping of SAE 1070 steel. The 10-station production machine automatically positions the hub ring in the drum stamping, presses the ring until it seats tightly against the recessed drum head, preheats the assembly in preparation for welding, produces an annular fillet weld in the corner where the edge of the ring contacts the drum head, removes the excess welding flux by suction and cools the assembly by air blast, jars fused flux loose from the weld and dumps it from the assembly, continues to cool the assembly at a second air blast station, and finally reheats the part to relieve stresses that may have been imposed in prior operations. The flow of work through the various stations of the machine is illustrated in *Fig.* 2.

Prior to entering the welding machine, both components of the ring gear carrier assembly undergo machining and heat treatment and are passed through a washer to remove oil, grease, dirt, and chips. The parts then are loaded into separate magazines which automatically feed the parts to the first two stations of the welding machine. The hub rings roll down an overhead track, *Fig.* 3, which orients them with the flange side up and feeds them into an escapement device. The drum stampings are positioned at the first station and then indexed to the second station where the escapement mechanism ejects a hub ring into the drum hole. After the ring is firmly seated in the hole by an automatic press, the assembly is indexed to the third station for preheating. A lower inductor is elevated inside the drum stamping and raises the parts up against an upper inductor. The parts are then automatically heated to a temperature of 500-600F by a 60-cycle induction heating machine.

After the preheat temperature is reached, the assembly is moved to the fourth station by the indexing mechanism and is lowered into a holder for the arc welding operation. This is accomplished by a Lincoln Electric Co. automatic submerged arc head that feeds 3/32-inch electrode wire to produce the annular fillet weld of the ring to the drum and shields the arc with granular flux, *Fig.* 4. During the welding operation, the holder slowly rotates the assembly through 380 degrees past the stationary electrode.

▶ Flux Recovery

As soon as the welding current is shut off, the transfer mechanism indexes the weldment to the fifth station where unfused flux is sucked up as the as-

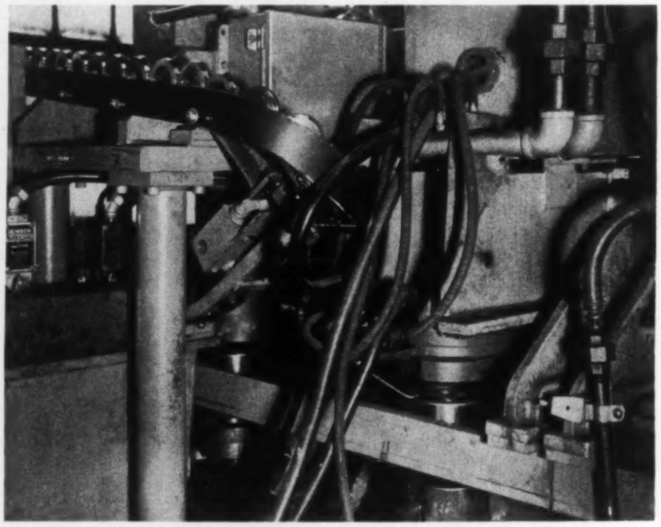
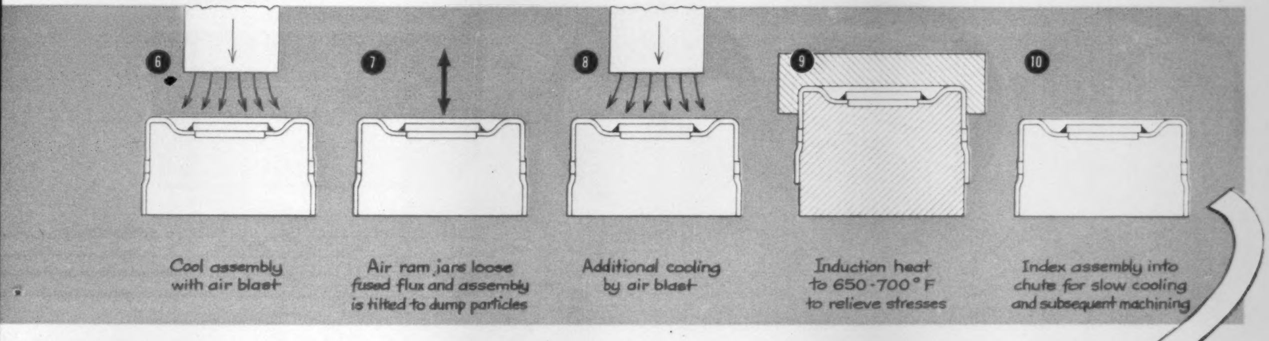
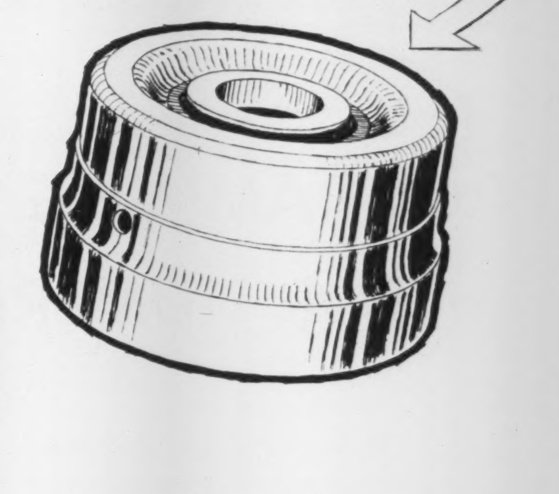


Fig. 3—Hub rings roll down an overhead track and enter an escapement mechanism. At the second station the rings are positioned and pressed into the drum stamping. Preheating of the assembly before welding occurs at the third station where a lower inductor elevates into the drum stamping and raises the part into contact with an upper inductor.


6
Cool assembly with air blast
7
Air ram jars loose fused flux and assembly is tilted to dump particles
8
Additional cooling by air blast
9
Induction heat to 650-700°F to relieve stresses
10
Index assembly into chute for slow cooling and subsequent machining



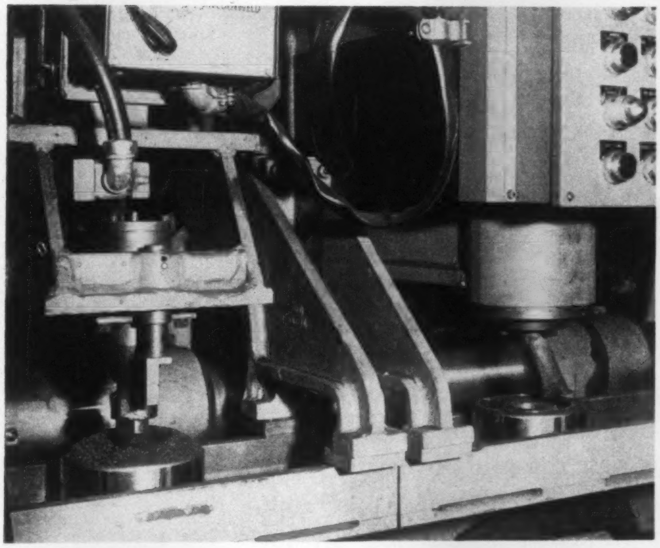


Fig. 4—After preheating, the assembly is indexed to the fourth station where shielded-metal-arc welding of the hub ring to the drum stamping occurs. Welding current of 400 amperes at 26 arc volts is supplied to the welding head by Lincoln Electric Co. equipment. Flux fed at this station and not fused is recovered by a vacuum system at the sixth station. Unused flux that is not recovered at this station drops into a screening mechanism below the parts. After fused particles are screened, the usable flux is cleaned of dust and returned to an overhead hopper for reuse at the welding station.

sembly rotates. Particles of flux which fall off the weldment at the welding, cleaning, or subsequent stations drop onto a shaker conveyor and screen below the stations. This unit screens out large fused particles and feeds the reclaimed material to a vacuum system which cleans dust from the flux and recirculates the flux back into the welding head flux hopper.

After indexing to the sixth station, the hot, welded assembly stops below a duct where an air blast speeds cooling of the weldment. This action continues until the unit is indexed to the seventh station for removal of any fused flux remaining on the weld. An air ram automatically jars the assembly, breaking loose the last residue to leave a clean weld. After jarring, the weldment is tilted so that flux particles drop onto the shaker screen below.

▶ Stress Relieving

Further cooling by air blast occurs at the eighth station using a branch duct of the sixth station system. After indexing, the weldment is reheated to 650-700F at the ninth station by upper and lower inductors that operate in a manner similar to those at the third station. The reheating operation is required because extremely close dimensional limits are involved when the ring gear carrier assembly is fitted into the torque converter transmission and these limits could not be maintained with certainty if stresses resulted in significant dimensional changes. Final indexing of the welded assembly at the last station feeds the parts into a chute for slow cooling as the units move to subsequent machining operations.

The entire machine process is self-controlled and requires only one operator. As part of a continuous production line, the machine is required to keep in step with prior and succeeding machining operations. Therefore, machine reliability was as important to Buick engineers as the necessity of producing a weld which is free of porosity and has good fusion and penetration.

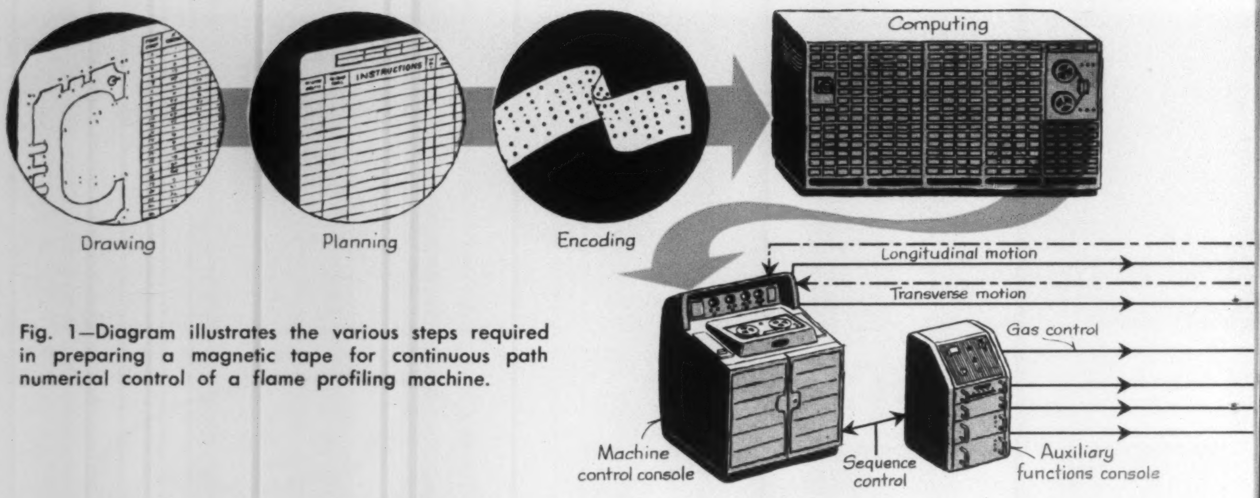


Fig. 1—Diagram illustrates the various steps required in preparing a magnetic tape for continuous path numerical control of a flame profiling machine.

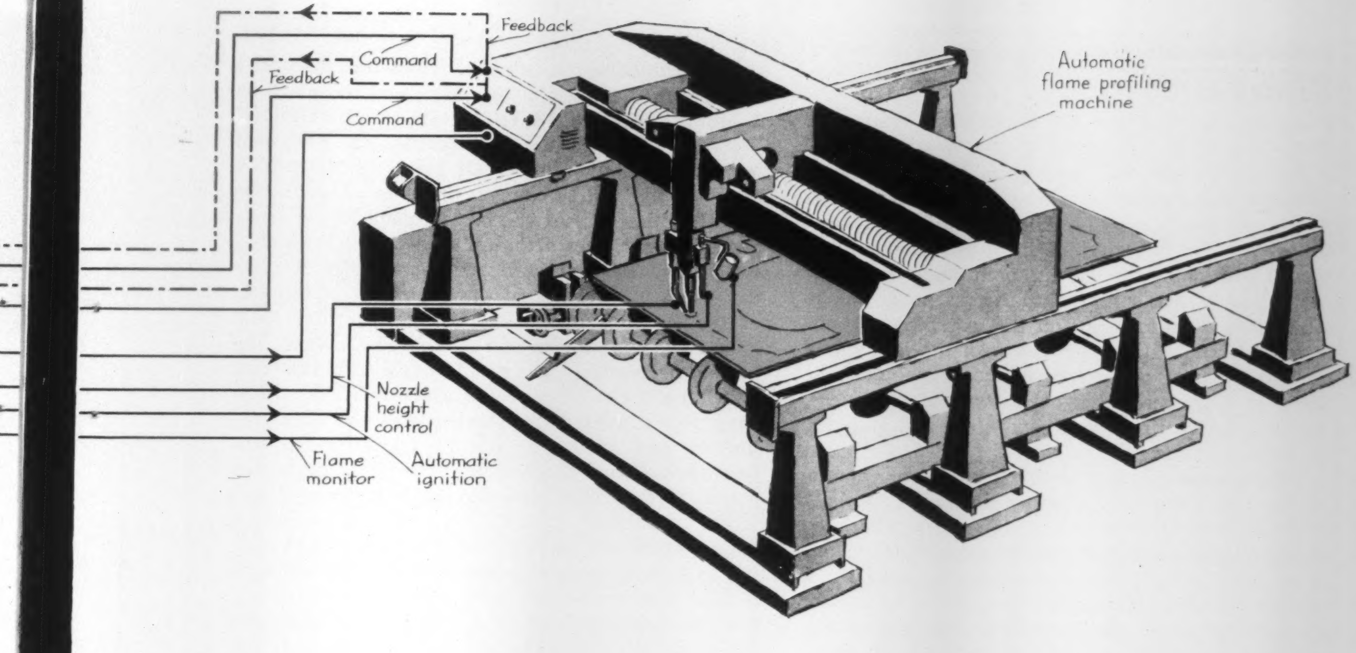
PROGRAMMING FOR NUMERICAL CONTROL

The economic and operational success of any numerically controlled machine depends to a large degree upon the speed and accuracy of programming the machine to perform the desired operations. While there is no single programming procedure that can be universally used for all numerically controlled machines, many of the programming steps outlined in this article are applicable in other programming systems.

By **LEO WALTER,** Consulting Engineer, Painswick, Nr. Stroud, Glos., England

IN SEPTEMBER 1952 an electronic device automatically operated a small milling machine in the Servomechanisms Laboratory of Massachusetts Institute of Technology. This was the first public demonstration of a new manufacturing technique called numerical control for machine tools. Since that date, numerical control systems have been applied to many types of machine tools such as skin mills and profilers, riveters, drilling machines, and punch presses. While much information has been disseminated concerning the mechanical and electrical capabilities of numerically controlled machines, little information has been published on the techniques of preparing the numerical data which controls the machines as they accurately and automatically perform the designated machining tasks. Depending upon the complexity of the numerical control system used and the degree of control exercised, data preparation or programming can vary from simple manual operations to highly complex digital computer computations.

At the present time, there is no single programming method that can be universally applied to all the different types and makes of numerically controlled machines. The state of the art is such that each numerical control system has its own particular method of programming which has been developed by the user of the system, the manufacturer of the system, and, if a computer is required, by the builder of the computer. Therefore, any detailed description of a programming method can be applied only to the equipment for which it was



designed. However, many of the general techniques used in a particular programming system are found in other systems.

▶ What Is Programming?

Programming may be considered as the translation and transformation of information on a working drawing of a part into suitable input data capable of controlling a numerically controlled machine. This input data usually consists of groups of command signals recorded on a magnetic or a punched paper tape. When fed into a machine director, these signals cause the director to initiate impulses to various sensing and movement devices on the machine for the positioning of either the work or the work performing means along designated axes. Auxiliary command signals included in the tape then control such actions as starting and stopping cutting means, changing the speed of cutting means, feeding the cutting means to and away from the workpiece, and starting and stopping the tape reader for each series of operations. The preparation of machine command instructions in an orderly manner so that the cutting means will faithfully follow the part outline in a systematic manner with as few steps as possible is called part programming.

Part programming entails many steps as shown in *Fig.* 1, the programming procedure for a numerically controlled flame profiling machine developed by two British firms, Ferranti Ltd. of Edinburgh and British Oxygen Gases Ltd. of London. This machine is used to flame cut large steel plates in shipbuilding and other steel fabrication industries. As shown in *Fig.* 2, the work being cut remains stationary on a

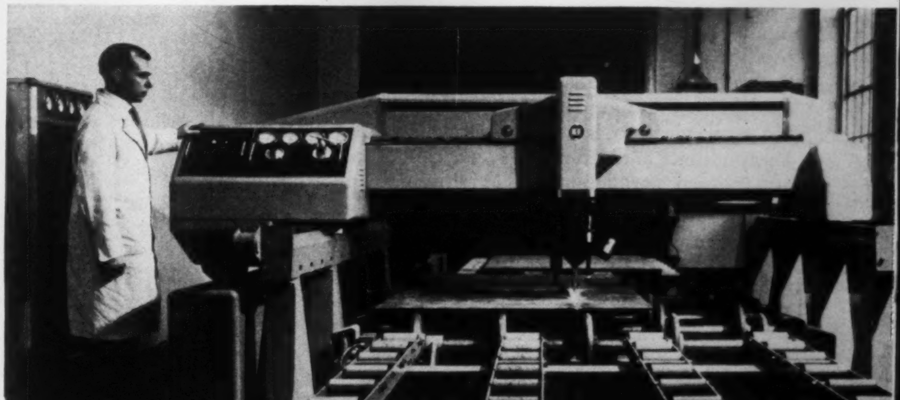


Fig. 2—In this flame profiling machine, the steel plate being cut remains stationary on the roller table. A magnetic tape controls the position of the cutting torch by moving the overhead bridge structure in a longitudinal direction and by moving the torch carriage in a transverse motion across the bridge structure.

roller table while the cutting torch moves longitudinally and transversely above the work as directed by the machine control system. The numerical control system for this machine involves a major function of positioning the cutting torch along the longitudinal or *X* axis and the transverse or *Y* axis in relation to a datum point on the workpiece. Auxiliary functions of the system control the ignition of the gas torch at the proper moment, maintain the torch at a constant height above the workpiece, monitor the cutting flame, and start and stop the tape reading mechanism.

The exact positioning of the cutting torch on the profiling machine is achieved by means of a specially prepared magnetic tape which is read or translated in the machine control console into electrical impulses that operate servomechanisms on the cutting equipment. In addition to the position control of the cutting torch, the magnetic tape carries appropriate signals to initiate the cutting torch flame and activate the various monitoring systems associated with it. In programming the flame profiling machine for numerical control of all operations, command instructions and data defining the part profile to be cut are prepared in a specific manner so that a punched paper tape can be processed to become a data input for the computer. This involves the reduction of all information to a form in which numbers are used to define rate, position, and hence ultimate shape; and combinations of letters and symbols are used to define command instructions.

▶ Preparation of Code Sheet

The first step in programming the flame profiling machine for numerical control is to prepare a sketch of the part to be produced on a code sheet as shown in *Fig.* 3. This sketch need not be an accurate scale drawing. The part is drawn so that a datum or zero point with respect to dimensions along the *X* and *Y* axes is in the lower left corner of the part profile. Co-ordinate dimensioning as distinct from conventional engineering drawing dimensioning is used. The datum point is related to a corner of the steel plate to be cut as defined by the plate's longitudinal and transverse edges. These edges are in turn parallel to the longitudinal and transverse motions of the profiling machine. Plate locating stops in the machine ensure that this relationship is maintained in practice. Therefore, the drawing datum, the edges of the plate, and the machine datum all bear a fixed relationship to one another.

Having sketched the part profile, the next step is to sequentially number all points of the profile at which the outline changes direction. This can be done in either a clockwise or counterclockwise direction. Straight lines are numbered at the beginning and end of each straight section. Circular arcs are numbered in sequence at the beginning of the arc, at the center of the circle from which they were generated, and at the end of the arc. When the outside perimeter of the profile has been numbered, all circles within the profile are numbered. Each circle has a number for the torch centerline allowing for kerf width, the starting point for the cutting torch around the circumference of the circle, the center of the circle, and the torch stopping point. These numbered points then become reference points which are used in the programming procedure as location points for the *X* and *Y* co-ordinates.

After the profile has been completely numbered, the numbers are listed in a tabular form alongside the drawing. For each numbered point, the longitudinal and traverse distances from the datum point are determined and listed as *X* and *Y* co-ordinates. Three other columns of information are used to note machine instructions. One column notes by code letters the change points at which the cutting torch and tape deck are started and stopped. Another column of data indicates the radii of the circular arcs and circles, and shows the change point at which a curve should be interpolated. The last column of the tabular form is used to note speed changes of the cutting torch and lists the fast traverse, cutting, and piercing speeds.

In addition to this information, the code sheet contains notes as to the fast traverse, cutting, and piercing speeds; the kerf width; the plate thickness to be used; and, in many cases, the most convenient size

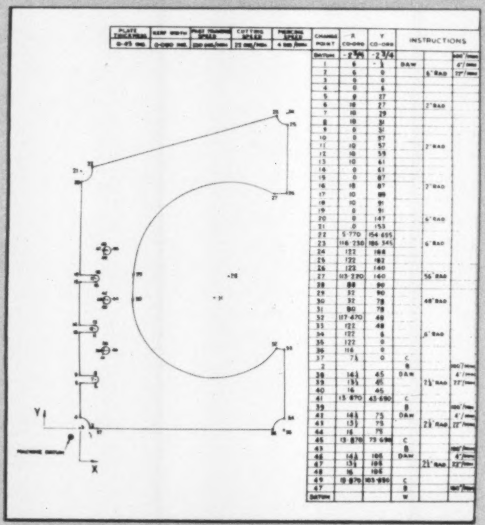
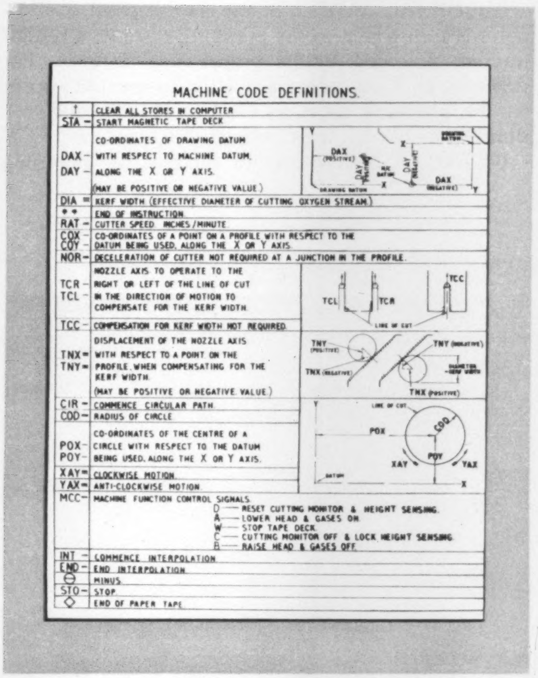


Fig. 3—Preparation of a code sheet is the first step in programming the flame profiling machine. The part to be cut is sketched and numbered at all points where the outline changes direction. The longitudinal and transverse distances of each numbered point from a datum point are then listed in a tabular form as X and Y co-ordinates of the point.



MACHINE CODE DEFINITIONS.

†	CLEAR ALL STORES IN COMPUTER
STA –	START MAGNETIC TAPE DECK
DAX – DAY –	CO-ORDINATES OF DRAWING DATUM WITH RESPECT TO MACHINE DATUM. ALONG THE X OR Y AXIS. (MAY BE POSITIVE OR NEGATIVE VALUE)
DIA =	KERF WIDTH (EFFECTIVE DIAMETER OF CUTTING OXYGEN STREAM)
* *	END OF INSTRUCTION
RAT –	CUTTER SPEED INCHES/MINUTE
COX – COY –	CO-ORDINATES OF A POINT ON A PROFILE WITH RESPECT TO THE DATUM BEING USED, ALONG THE X OR Y AXIS.
NOR –	DECELERATION OF CUTTER NOT REQUIRED AT A JUNCTION IN THE PROFILE.
TCR – TCL –	NOZZLE AXIS TO OPERATE TO THE RIGHT OR LEFT OF THE LINE OF CUT IN THE DIRECTION OF MOTION TO COMPENSATE FOR THE KERF WIDTH.
TCC –	COMPENSATION FOR KERF WIDTH NOT REQUIRED.
TNX = TNY =	DISPLACEMENT OF THE NOZZLE AXIS WITH RESPECT TO A POINT ON THE PROFILE, WHEN COMPENSATING FOR THE KERF WIDTH. (MAY BE POSITIVE OR NEGATIVE VALUE)
CIR –	COMMENCE CIRCULAR PATH.
COD –	RADIUS OF CIRCLE
POX – POY –	CO-ORDINATES OF THE CENTRE OF A CIRCLE WITH RESPECT TO THE DATUM BEING USED, ALONG THE X OR Y AXIS.
XAY =	CLOCKWISE MOTION.
YAX =	ANTI-CLOCKWISE MOTION.
MCC –	MACHINE FUNCTION CONTROL SIGNALS. D — RESET CUTTING MONITOR & HEIGHT SENSING. A — LOWER HEAD & GASES ON. W — STOP TAPE DECK. C — CUTTING MONITOR OFF & LOCK HEIGHT SENSING. B — RAISE HEAD & GASES OFF.
INT –	COMMENCE INTERPOLATION
END –	END INTERPOLATION
⊖	MINUS.
STO –	STOP.
◇	END OF PAPER TAPE

Fig. 4—Combinations of code letters are used to furnish a means of communication between the programmer and the computer. When programmed into the computer prior to the preparation of a magnetic tape, these code words define the command instructions and set up a procedure for computing a particular profile path.

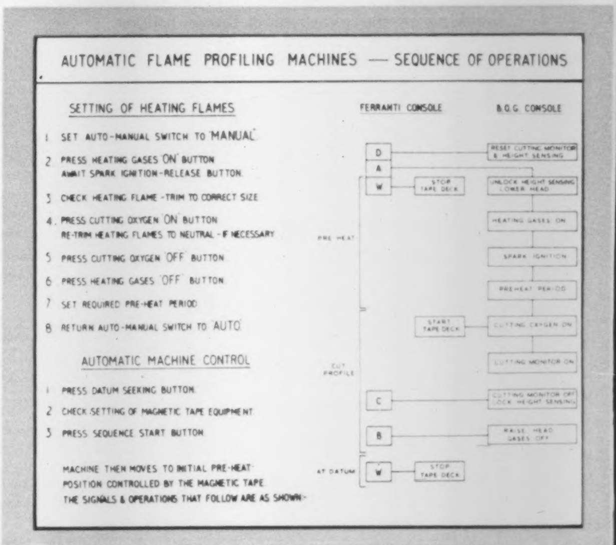
of rectangle from which the desired profile may be produced. After the code sheet has been fully prepared, it is used in the preparation of a planning sheet which becomes the basis for input data to the computer.

▶ Use of Code Letters

Numerical data such as the *X* and *Y* co-ordinate designations can be accepted as input data by the computer and used to prepare the magnetic tape output. However, additional instructions are necessary in order to direct the computer in defining the cutting path around the part profile. To conserve the data storage space within the computer, these instructions are condensed into a series of code letters which are known as computer language. Prior to the preparation of a magnetic tape by the computer, the code letters are programmed into the computer along with instructions as to what the computer is to do when the code letters appear in subsequent input data. By combining various code letters and numerical co-ordinates, the computer can be instructed to perform the operations necessary for directing the cutting torch in straight, circular, or inclined paths.

The code letter designations for defining the longitudinal and transverse motions of the cutting torch are shown in *Fig.* 4. For example, when the code letters *STA* are used, the computer is instructed to start the magnetic tape deck. Code letters *COX* are always used preceding the numerical designation of a dimension along the *X* co-ordinate. Similarly, the code letters *COY* indentify a *Y* co-ordinate dimension. Co-ordinates of the center of a circle with respect to the datum being used are preceded by the code letters *POX* along the *X* axis and *POY* along the *Y* axis. In directing the cutter along a circular path, the code letters *XAY* are used to denote clockwise motion, and the letters *YAX* denote counterclockwise motion. Many other code letters are used in the vocabulary to define all possible motions of the flame profiling machine.

Another set of code letters, *Fig.* 5, is used to actuate and control the cutting torch flame. For example, the code letter *A* is used to activate seven sequential operations involved in starting the oxygen cutter. These operations are: 1. Unlock the height sensing unit and lower the head. 2. Turn on heating gases. 3. Ignite heating gases. 4. Time the preheat period. 5. Turn on the cutting oxygen. 6. Start the magnetic tape deck. 7. Turn on the cutting monitor. A view of the cutting head is shown in *Fig.* 6. The purpose of the height sensing unit is to maintain a constant height between the tip of the cutting nozzle and the plate surface. The cutting monitor contains a photoelectric cell and



AUTOMATIC FLAME PROFILING MACHINES — SEQUENCE OF OPERATIONS

SETTING OF HEATING FLAMES

1 SET AUTO-MANUAL SWITCH TO 'MANUAL'
2 PRESS HEATING GASES 'ON' BUTTON
AWAIT SPARK IGNITION-RELEASE BUTTON.
3 CHECK HEATING FLAME - TRIM TO CORRECT SIZE
4. PRESS CUTTING OXYGEN 'ON' BUTTON
RE-TRIM HEATING FLAMES TO NEUTRAL - IF NECESSARY
5 PRESS CUTTING OXYGEN 'OFF' BUTTON
6 PRESS HEATING GASES 'OFF' BUTTON
7 SET REQUIRED PRE-HEAT PERIOD
8 RETURN AUTO-MANUAL SWITCH TO 'AUTO'

AUTOMATIC MACHINE CONTROL

1 PRESS DATUM SEEKING BUTTON
2 CHECK SETTING OF MAGNETIC TAPE EQUIPMENT
3 PRESS SEQUENCE START BUTTON

MACHINE THEN MOVES TO INITIAL PRE-HEAT POSITION CONTROLLED BY THE MAGNETIC TAPE THE SIGNALS & OPERATIONS THAT FOLLOW ARE AS SHOWN-

Fig. 5—Code letters are also used to actuate and control the automatic cycle of the cutting torch. Prior to actual cutting, the torch is manually adjusted to accommodate the thickness of plate which influences the cutting oxygen pressure. The preliminary setup and operating steps are shown in the sequence at the left of the chart.

detects and confirms the presence of the preheat flame. If the flame should malfunction during a cutting operation, the cutting monitor will shut down the machine.

Prior to the cessation of cutting, it is necessary to switch off the cutting monitor and to lock the height sensing head. These functions are controlled by the code letter *C*. Code letter *B* raises the head and shuts off the flow of cutting oxygen and heating gases. When the cutting torch code letters are used in programming, they are always preceded by the code letters *MCC*. For example, the starting instruction is always *MCC* = *DAW* ≡. Operating instructions are *MCC* = * * *C* ≡ and *MCC* = *B* ≡, and the stopping instruction is MCC = W ≡ which stops the tape deck at datum. The symbol * * is used to denote the end of an instruction.

Preparing the Planning Sheet

A planning sheet, *Fig.* 7, is used to lay out the accumulated data from the code sheet into coded information suitable as an input to the computer. The lines on which the information is to be written are numbered, and each of the change point co-ordinates is transferred to the planning sheet as a 6-digit number preceded by its proper code letters. For example, an *X* co-ordinate of 10 inches would appear on the planning sheet as *COX* - 010000, and a *Y* dimension of $\frac{3}{4}$ inch would be listed as *COY* - 000750. A double line in each of the planning

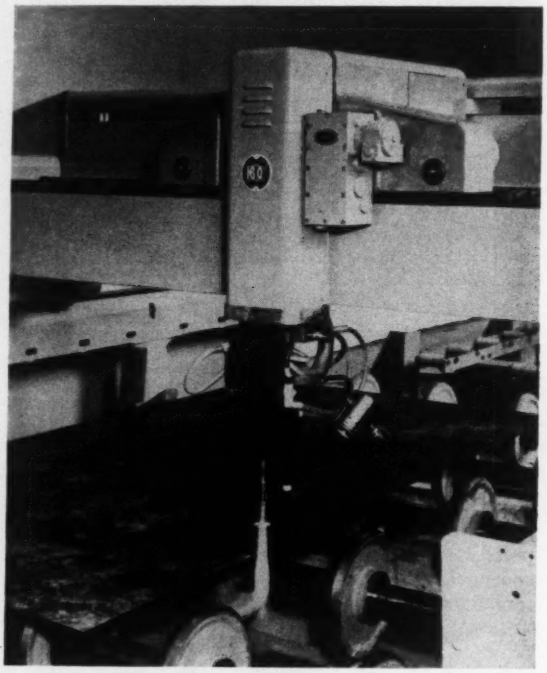


Fig. 6—During cutting, torch operation is automatically monitored to maintain optimum conditions. The ring between the nozzle and the plate is part of a height sensing device to maintain a constant height between the nozzle tip and the plate surface. The rod at the right of the nozzle is an automatic ignition device. The photoelectric cell to the right of the ignition rod detects the presence of the flame and shuts down the machine in the event of a flame failure.

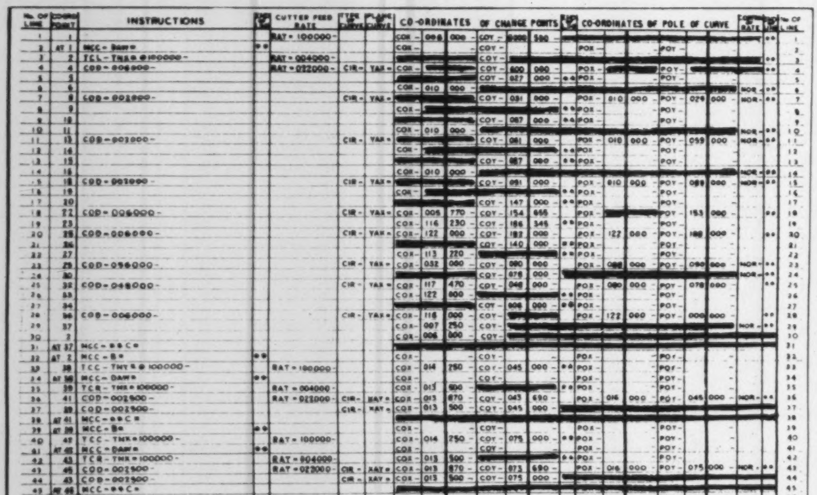


Fig. 7—Information accumulated on the code sheet is transferred to this planning sheet and combined with the proper code letters designating the desired machine operations. Unwanted information in each instruction is deleted from the preprinted form by drawing a heavy line. Final step in programming is the transfer of each line of data on the planning sheet to the keyboard of a teleprinter machine which punches a paper tape for the computer input.

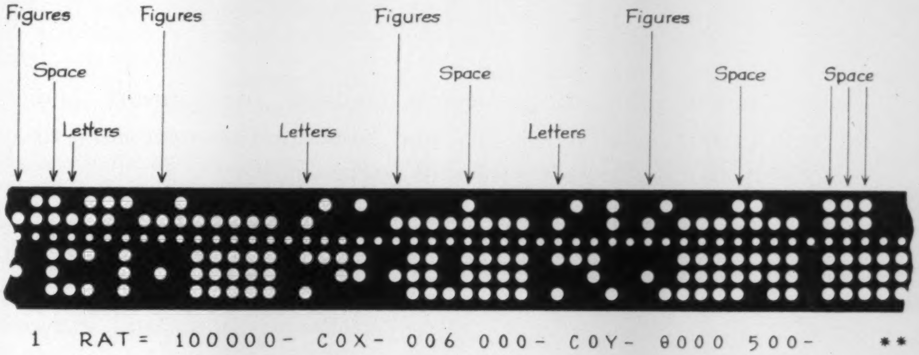


Fig. 8—Sample piece of punched tape illustrates the manner of coding the information contained on the planning sheet. The example shown was encoded from the first line of data on planning sheet of Fig. 7.

sheet columns represents the location of a decimal point in that the first three digits of the number are whole numbers, and the last three digits are the decimal fraction. When circular configurations are required, the code letters *CIR* are placed in the *Type of Curve* column; the code letters *XAY* or *YAX*, denoting clockwise or counterclockwise motion, are inserted in the *Plane of Curve* column; and the centers of the circles are defined by the codes *POX* and *POY* followed by a 6-digit number in the *Co-ordinates of Pole of Curve* columns. The speed of the cutting torch is indicated by the code *RAT* = followed by a 6-digit number such as 022000 denoting a speed of 22 inches per minute. At the end of each instruction, two asterisks (* *) are placed, and any unwanted information between the beginning and end of each instruction is deleted by scoring through with a heavy line.

A typical coded command would be written as follows: 29 *COD* = 056000 *RAT* = 022000 - *CIR* = *YAX* ≡ *COX* - 032000 - *COY* - 090000 - *POX* 088000 - *POY* - 090000 - *NOR* = * * . When translated into computer instructions, this coded command says, "Between the last point and the next co-ordinate point at 29, there is a circle with a radius of 56 inches. Using a cutter feed rate of 22 inches per minute, commence a circular path with a counterclockwise motion to this point at *X* axis equal 32 inches and *Y* axis equal 90 inches with respect to datum. Center of the circle with respect to datum is *X* axis equal 88 inches and *Y* axis equal 90 inches. Deceleration of the cutter is not required at the junction in the profile. End of instruction."

At the top of each planning sheet are placed identification data, the *X* and *Y* co-ordinates of the datum point, and the kerf width. The information on the planning sheet is then transferred line-by-line to the keyboard of a Creed Teleprinter machine which simultaneously punches a paper tape and produces a typed copy of the letters, figures, and symbols for checking purposes. The encoded punched tape, *Fig.* 8, is then sent to a computer center where it serves as a data input to a computer programmed with the code letter instructions. Output of the computer is a magnetic tape capable of automatically operating the numerically controlled flame profiling machine.

The part programmed in this operation is a typical ship profile, namely a lower stringer in a forward wing tank. The total length of cut around the profile is 72 feet. Total programming and cutting time for this part was approximately 162 minutes. This included 85 minutes for compiling the planning sheet, 30 minutes for encoding the punched paper tape (typing), 3 minutes for computing the magnetic tape, and 44 minutes actual cutting time on the machine. When compared to existing methods of profile manufacture, which require the making of templates and marking out of the templates on the steel plate, cost savings in the neighborhood of 38 per cent are easily realized.

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HIGH-SPEED PARCEL SORTING

Unique combination of conveyors, controls, mechanisms, and humans provides the versatility and co-ordination necessary to effectively handle large volumes of parcel mail.

DURING the last several years, the Post Office Department has instituted numerous projects aimed at speeding the flow of both letter and parcel mail. Among the projects concerned with improving the handling of parcels is a mechanized sorting system supplied by Nelson Laboratories Inc. Identified as the Greller sorting system, the installation is located at the Baltimore Parcel Post Station—a station that is called upon to sort as many as 60,000 parcels during a normal day and over 150,000 parcels per day during the Christmas rush season.

The general problem of sorting involves such variables as quantity, size, handling limitations, time of arrival, method of arrival, method of designating destination, destination, and method of departure to name but a few.

The general solution to the sorting problem at the Baltimore installation, *Fig.* 1, involves transporting all incoming parcels via a conveyor to a 2,000 parcel slide. Parcels are individually removed from the slide by personnel. The destination of parcels is noted, and a number code is penciled on the surface of each parcel. An initial sort is then accomplished by placing a parcel on one of two conveyors leading to the mechanized sorting system.

The two conveyors serving the system are arranged to enter opposite ends of the system such that the paths of flow are side-by-side but running in opposite directions. A keying station, manned by an operator, and various control devices are located alongside each conveyor at the point it enters the sorting system, *Fig.* 2. By manipulating pushbuttons to correspond with the penciled code on each parcel,

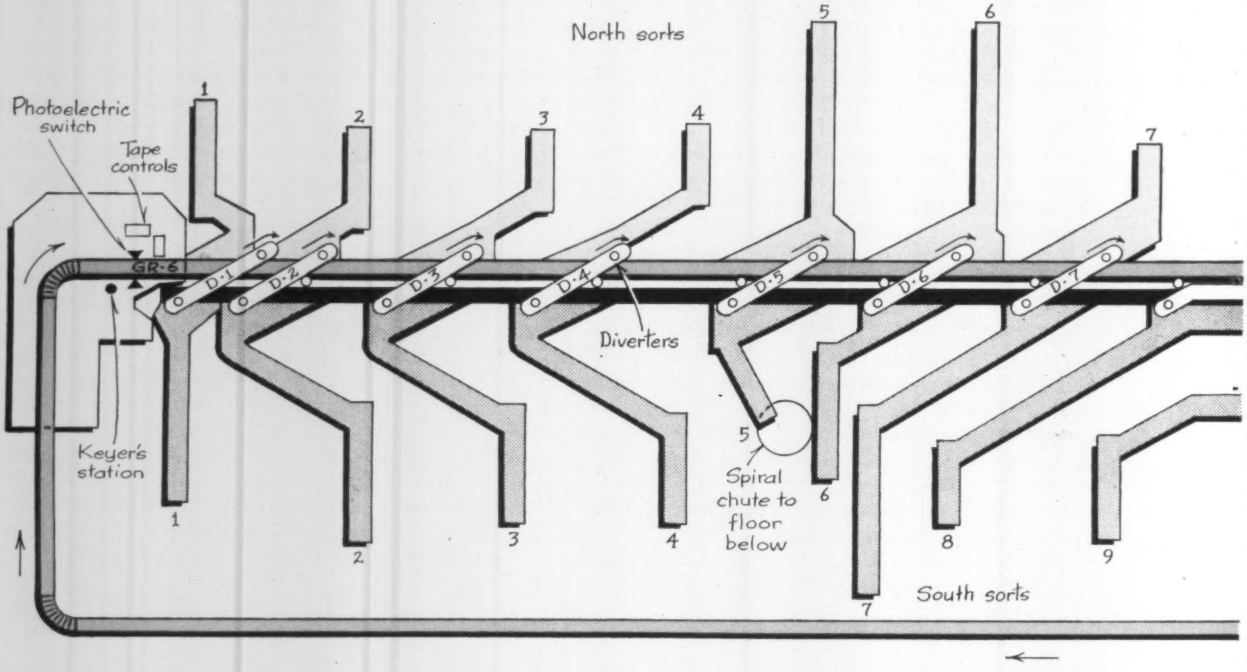


Fig. 1—Schematic diagram indicates layout of mechanized parcel sorting system at Baltimore Parcel Post Station. Parcels are conveyed from slide area via one of two conveyors that are arranged to enter system from opposite ends. Layout permits use of 11 Greller diverters to serve 21 sorting stations.

the operators set in motion a train of events which culminate with parcels being selectively diverted off the conveyor at desired points. Subsequently, the parcels are subjected to a secondary manual sort, sacked, and sent on their way.

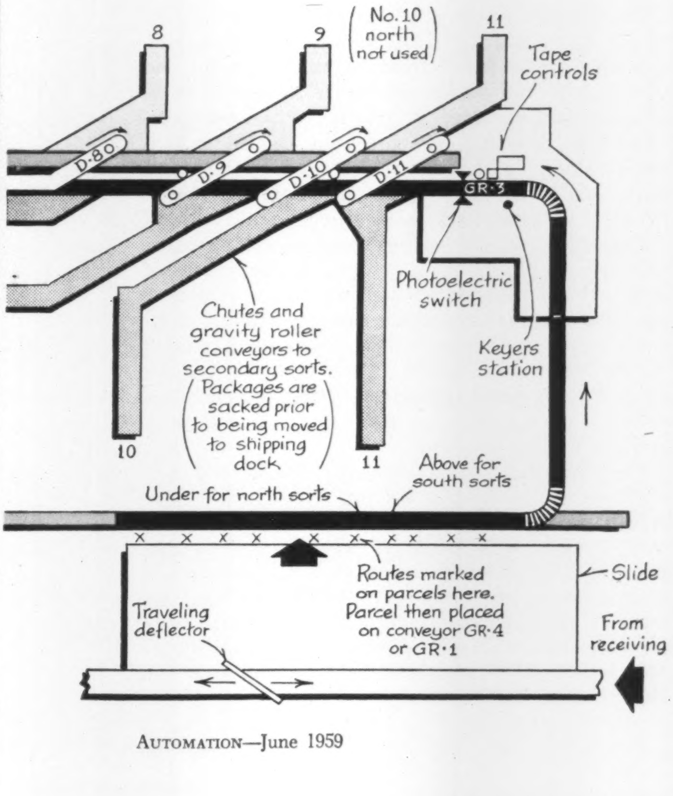
With the conveyor belts carrying parcels at a speed of 200 feet per minute, selectively diverting packages off a conveyor, without interfering with other packages on the conveyor, presents an interesting problem—and the unique features of the system are the control equipment and the diverters that solve this problem.

▶ Control Actions

Representing the point at which a parcel is to be diverted, the signal created at the pushbutton station is initially stored in a capacitor type memory. Capable of storing signals for as many as 50 parcels, the memory delivers up signals in the same sequence as they are received. This sequence corresponds to the order of the parcels on the conveyor as they passed the keying station.

Among other elements, the control equipment for each conveyor includes a magnetic tape unit that contains a number of separate tape processing devices, including individual write and read heads. There is a separate device for each diverter position in the system.

A continuously moving loop of tape in each device travels at a speed proportionate to the conveyor speed. The read head of each device is separated from the write head by a distance that is proportionate to that separating a particular diverter and a photoelectric relay at an indexing point at the head end of the parcel conveyor.


8
9
No. 10 north not used
11
Tape controls
D·8
D·9
D·10
D·11
GR·3
Photoelectric switch
Chutes and gravity roller conveyors to secondary sorts.
Packages are sacked prior to being moved to shipping dock
Keyers station
10
11
Above for south sorts
Under for north sorts
Routes marked on parcels here. Parcel then placed on conveyor GR·4 or GR·1
Slide
Traveling deflector
From receiving

As parcels move down the high speed line, they in turn arrive at and actuate a photoelectric relay at the indexing point. With this, the sequential memory delivers up its signal indicating the desired diverting point. These actions actuate the appropriate write head in the tape unit, causing a signal to be impressed on a tape for so long as the photoelectric relay is actuated. The tape length of the signal is thus proportional to the belt length of a given parcel in each sorting operation.

As a parcel moves along the belt toward the station at which it is to be diverted, the signal on the magnetic tape approaches its read-head. At the proper moment, the signal is sensed by the read-head and, by means of the station control, is amplified and transmitted to a solenoid which in turn controls a mechanical switching device at the diverter.

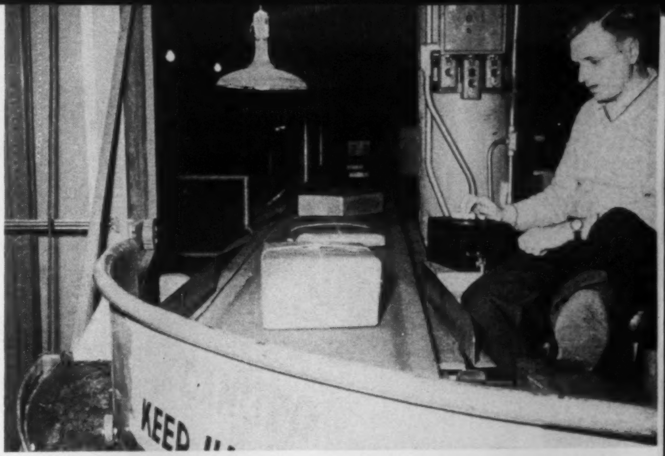


Fig. 2—As parcels reach the beginning of a high speed conveyor that passes beneath diverters, operator places signal into control system by means of pushbutton console to indicate desired point packages are to be diverted off conveyor. Each package has previously been examined and a pencil notation placed on its surface to guide the pushbutton operator.

▶ Diverter Operation

A diverter consists of a series of paddles or slides, in this case approximately 3¼ inches wide by 30 inches long, which are mounted vertically on 4½-inch centers between two loops of drive chain which rotate in a horizontal plane. The chains are driven by sprockets mounted on shafts and a structural frame holds the shafts in position and supplies the necessary rigidity to the diverter. The diverter is placed high enough over the belt so that in the nondiverting position there is enough clearance under the paddles to allow all parcels to flow unobstructed along the belt, *Fig.* 3.

The individual paddles can extend downward in a sliding, telescopic motion, and divert parcels off the belt, after which they return upward to their original position. The major axis of a diverter intersects the axis of the conveyor at an angle of ap-

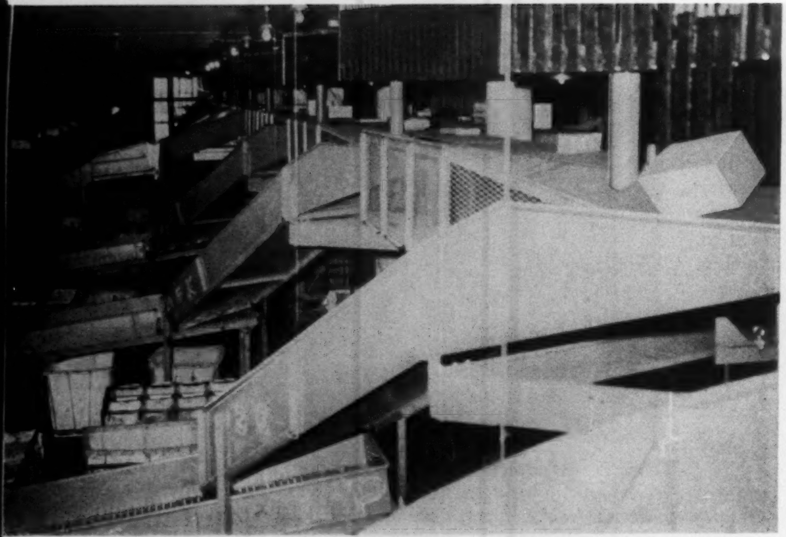


Fig. 3—Photograph indicates arrangement of diverters along length of conveyor and associated slides and roller conveyor sections at each sorting station. Diverters are placed at an angle to direction of conveyor travel in order to provide a smooth diverting action as parcels are guided off the conveyor.

proximately 25 degrees. The speed of diverter elements passing over the conveyor belt is adjusted so that the component velocity in the direction of belt flow is equal to the belt speed. Thus, a smooth diverting action is obtained.

In order to divert parcels from the belt, the necessary number of paddles is automatically switched from the upper to the lower position. As these paddles intersect the line of flow of the belt, they form a live diverter, or wall, which gently moves the parcel off the belt, *Fig.* 4. The switching of the paddles from the upper to the lower position is effected by the solenoid controlled switch previously mentioned. Since this solenoid in effect responds to the signal on the magnetic tape, the length of time the solenoid continues to cause paddles to switch is equal to the time length of the signal originally impressed on the tape by the parcel as it actuated the photoelectric relay at the indexing point. Therefore the number of paddles moved to the down position to act as a diverter will result in a wall length approximately equal to the belt length of the parcel being diverted.

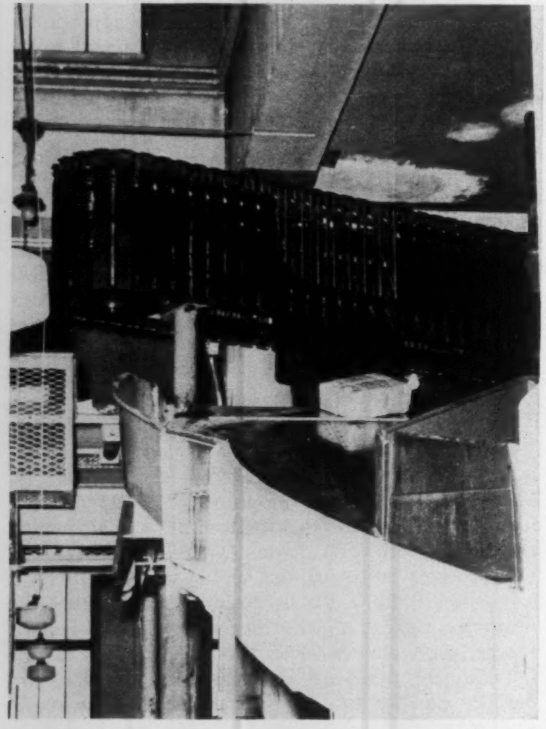


Fig. 4—The signal that triggers the diverting action is a function of the belt length of each parcel. This variable signal allows one or more of the movable paddle elements of the diverter to drop down from a normal position and create a given size moving barrier that guides parcels off the conveyor.

The physical moving of the paddle from the up to the down position is accomplished by switching a double guide wheel from its stirrup at the top of the guide rail which allows the paddle to move down an incline, aided by gravity, to its lower position. After diverting the parcel the paddle, as it is moved along by the chains, is raised by the same guide rail to the upper position, where the double wheel is switched back to its stirrup.

Regardless of the varied sizes of the packages, they can be placed on the belt 12 inches apart and they will be diverted at the correct destination in the proper order. Since the diverter paddles create walls which are approximately equal to the length of the individual parcels, there is no belt space wasted when small parcels are being diverted, and there is no question of not having a wall large enough for long packages.

At a belt speed of 200 feet per minute and with packages whose lengths average 2 feet, the system will handle 4000 packages per hour on each belt or a total of 8000 packages per hour for the system. With packages whose lengths average 18 inches, the system will handle 4800 packages per hour on each belt or a total of 9600 per hour. With packages whose lengths average 1 foot, the system will handle 6000 packages per hour on each belt or a total of 12,000 packages per hour.

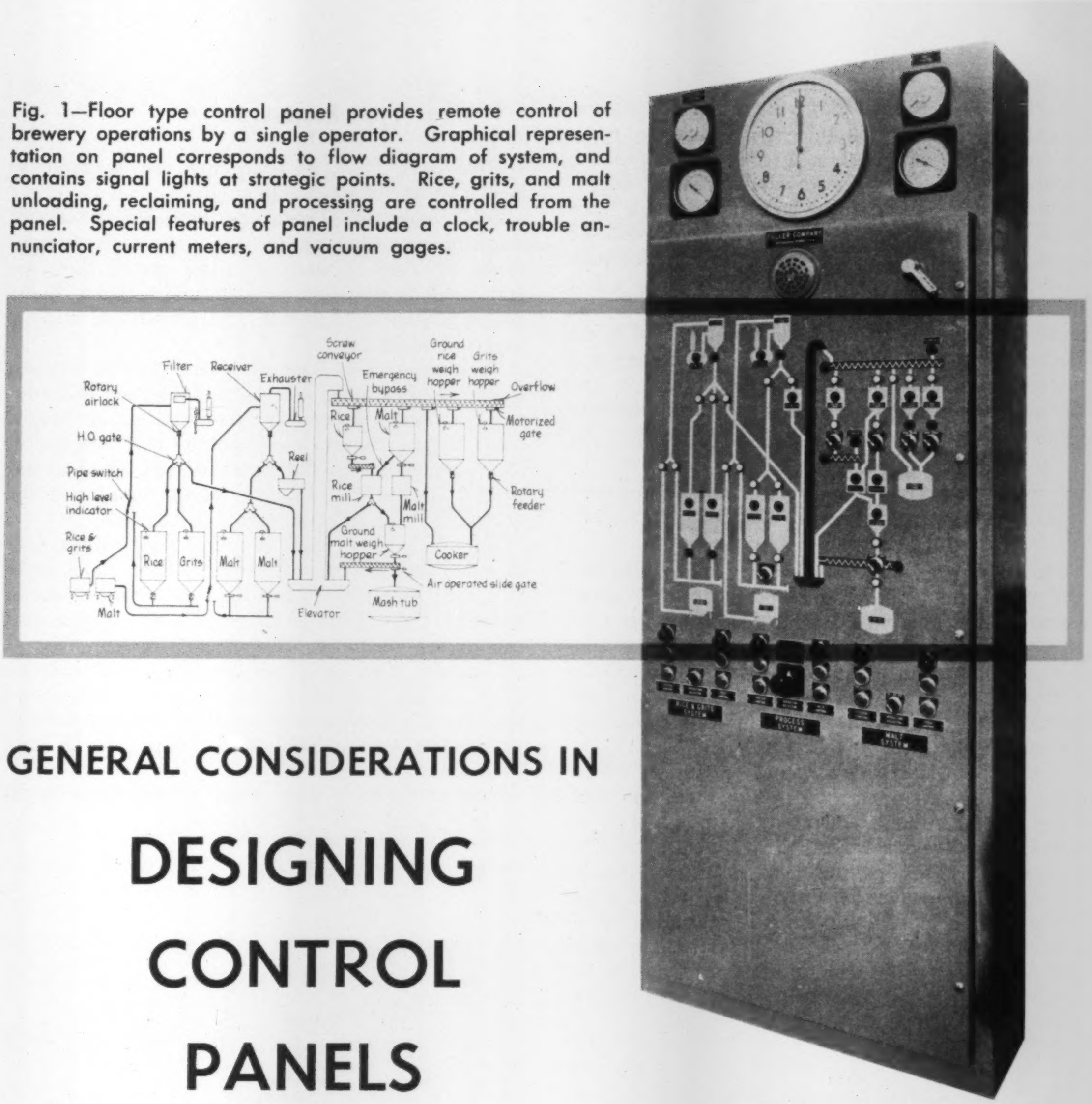

Rotary airlock
Filter
Receiver
Exhauster
Screw conveyor
Emergency bypass
Ground rice weigh hopper
Grits weigh hopper
Overflow
Motorized gate
H.O. gate
Reel
Rice
Malt
Pipe switch
High level indicator
Rice mill
Malt mill
Rotary feeder
Rice & grits
Rice
Grits
Malt
Malt
Ground malt weigh hopper
Cooker
Air operated slide gate
Malt
Elevator
Mash tub
RICE & GRITS SYSTEM
PROCESS SYSTEM
MALT SYSTEM

Fig. 1—Floor type control panel provides remote control of brewery operations by a single operator. Graphical representation on panel corresponds to flow diagram of system, and contains signal lights at strategic points. Rice, grits, and malt unloading, reclaiming, and processing are controlled from the panel. Special features of panel include a clock, trouble annunciator, current meters, and vacuum gages.

GENERAL CONSIDERATIONS IN

DESIGNING CONTROL PANELS

By CARL BAST
Chief Electrical Engr., Fuller Co.
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Nerve center of an automatic control system, a well-designed control panel reflects good electrical and mechanical practice, meets code requirements, is convenient and safe to operate, and is strategically located with respect to the controlled equipment. These and other factors important to designers and users of control panels are discussed and illustrated.

ONE OF THE basic functions of a control panel is to combine, in a centralized unit, those elements—motor starters, disconnect switches, relays, pushbuttons, timers, indicators, etc.—needed for effective, safe operation of machines or processes. Stationed at a single, remote control panel, an operator can initiate, control, and shut down a complex operation or process at will. Also, damage to equipment or products that might result from improper manual operation can be prevented by incorporating safety devices and automatic alarms in the control panel. A well-designed control panel can serve the further purpose of enabling rapid system troubleshooting and repair.

Because of the many functions combined in a control panel, and its importance to the successful over-all operation of a machine or process system, great care is necessary in its planning, design, and fabrication. Therefore, the decision whether to make or buy a control panel is directly related to the experience and know-how available. Many manufacturers have successfully constructed their own units. The risk in this course, however, can be great, and many companies prefer to contract such work. In either event, many considerations affect the choice of type of panel to be used, the layout, and the devices included. Descriptions of some Fuller Co. control panels used with processing and material handling installations, *Fig.* 1 and 2, and the general discussion to follow, will exemplify some of the factors involved.

▶ First Considerations

As a first step, the functions expected of the control panel should be outlined. What is the control panel to do? This will depend greatly on the type, size, and complexity of the operation to be controlled. Based on this information, a preliminary estimate can be made of the type of panel and the major components, devices, and indicators that will be used.

Location of the control panel will affect its design. This location may be in the shop, the millroom, or even the foreman's office. In general, the panel should be placed in an available space that is most convenient for the personnel responsible for its operation. An assessment of the over-all plant layout will help determine the best location or reveal ways in which it can be provided. Occasionally, the most convenient location will not be directly usable, and special mounting may be required.

▶ Codes and Standards

Beyond the general knowledge of what the panel is to do, there are specific areas of information which must be kept clearly in mind. Most important among these is a familiarity with the codes, especially local (city) codes, which have been established by authorities for safe operations. These codes can vary drastically from one locale to another, and should be thoroughly investigated even before preliminary panel plans are drawn.

Various association and institutional codes and standards should also be consulted. Many of these contain helpful information on design and construction requirements for enclosures and panelboards of different types. Other pertinent information—classification of hazardous locations and precautions to be observed, mounting of safety overload and short circuit devices, etc.—can be found in such publications. Familiarity with these codes and standards can save a great deal of time and expense, especially when their provisions are mandatory. Some of the major organizations that publish standards and codes of interest to control panel designers and users are listed in TABLE 1.

▶ What Type Enclosure?

Four basic types of enclosures are available to meet a variety of applications:

Wall mounted: These are available in several standard sizes that permit a variety of equipment to be enclosed. Usually of sheet metal, they are fabricated by shearing, bending, and welding. Backs are unperforated. Access to the panelboard is by a hinged front door.

Floor type: The floor type enclosure is fastened to the floor with anchor bolts. Indicators and control pushbuttons may be mounted on a hinged door. Relays, timers, and other control components are mounted inside the enclosure and wired to terminals at the top or bottom of the interior of the enclosure. The interior should be lighted.

Cubicle: This is the "walk-in" type with a door at either or both ends. Removable floor plates make this type ideal for mounting over conduit pits or wireway trays. Interior lights, a clock, and a dust canopy are available.

Console: This type is a modified floor cabinet. It is usually tailored to suit a special need, and may have a sloping surface on which pushbuttons and indicators are mounted, or other special constructional features.

Any of the four basic types of enclosures—wall-

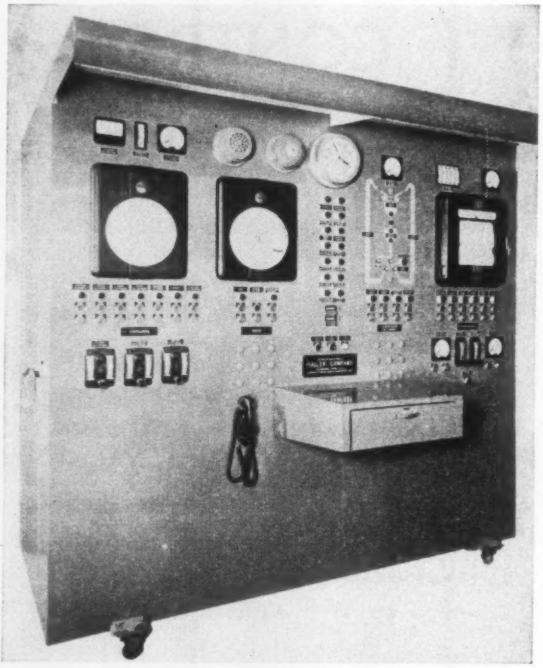


Fig. 2—Cubicle type control panel contains door on side for access to internal components and wiring. Designed to control a kiln operation in a cement plant, panel has recorders for gas and material temperatures, gas analysis, and draft. Accessories include dust canopy, telephone unit, and writing desk.

TABLE 1—Some Organizations That Publish Codes and Standards Relating to Control Panel Design

Issuing Group	Typical Publication
American Standards Association Inc. 70 East 45th St. New York 17, N. Y.	Various American Standards
Joint Industry **Conference** P. O. Box 182 Detroit 2, Mich.	Joint Industry Conference (J.I.C.) Electrical Standards
National Electrical Manufacturers Association 155 East 44th St. New York 17, N. Y.	Control, Industrial
National Fire Protection Association 60 Batterymarch St. Boston 10, Mass.	National Electrical Code
National Machine Tool Builders' Association 2071 East 102nd St. Cleveland 6, Ohio	Machine Tool Electrical Standards
Underwriters' Laboratories Inc. 161 Sixth Ave. New York 13, N. Y.	Industrial Control Equipment

mounted, floor type, cubicle, and console—can be furnished in explosion-proof form for use in hazardous locations. In general, wall-mounted and floor type enclosures are designed so that one man can control many operations. The same is usually true of consoles, but cubicles are normally employed for control of complex actions by more than one operator.

▶ Frequent Oversights

A common error in the design of a control panel is to omit adequate safeguards for short circuit and overload protection. Equipment should also be protected electrically against mechanical malfunctions such as failure of a valve to position properly. When such precautions are not taken, production can be stopped and plant personnel held idle for long periods of time.

Also frequently overlooked is a built-in system for checking that a control command has actually been executed. Often, the control panel is at a remote point so that machine actions cannot be observed directly. In other instances, response of a system to control commands is not manifest in a visible form. Therefore, checking means should be provided to inform the operator that the system is responding to his commands.

Accessibility to controls is an important feature, especially in an emergency. The same is true for the internal arrangement and wiring of the panel. A clean layout of components and wiring can greatly facilitate maintenance. Visible and audible alarms can also assist rapid maintenance by pinpointing troubles.

A wiring diagram and complete operating instructions should be available with each control panel. A common practice is to insert these items in a data pocket attached to the inside of the enclosure. A permanent metal pocket is preferred.

▶ Ordering a Control Panel

If a control panel is to be purchased, the fabricator will require a detailed and accurate flow diagram of the operation to be controlled. Along with this he will want to know production or use rates. In a bulk material handling installation, for example, he will require filling rates for hoppers and information on the amounts of material flowing from one place to another, preferably on an hourly basis. If future expansion is contemplated, allowance should be made at the time of ordering the control panel. Changes and additions made at a later date can require considerable outlay.

Questions will also arise with respect to motor ratings so that proper overload protection can be made an integral part of the control panel. Voltage, phase, frequency, speed, horsepower, frame size, and full-load current should be given for each motor controlled.

There are available many special components—clocks, counters, recorders, communication systems, level indicators, etc.—that can be included in a control panel and which may facilitate operation, adjustment, and control of machines or processes. A knowledge of the availability of applicable devices will enable these to be specified in the original order. Special background colors and symbols can also be called for.

Occasionally, it may be necessary to make minor modifications to the controlled system itself, in order to accommodate special control features which may be desired. If these control features provide substantial operating or maintenance advantages, system changes should be welcomed.

BARS FORMED AND WELDED IN

CONTINUOUS GRATING PRODUCTION

A COMPREHENSIVE 7-year research and development program preceded the introduction of automatic equipment capable of producing industrial floor grating or grille-type building material at a rate of 5000 sq ft per 8-hour shift. Developed by Bustin Steel Products Inc., the system operates under the supervision of a single operator, accomplishing the work formerly requiring 24 persons, *Fig.* 1.

Load-bearing grating, a product typical of that produced by the equipment, consists of a number of bars that have been formed into a corrugated shape and welded to each other, resulting in a honeycomb pattern in the finished product. To improve the characteristics of the grating for industrial flooring use, the upper edges of the bars are serrated.

The research program included development of a 1/3-size model to test the progressive feeding and indexing mechanisms intended for use in the final system. Also, working with Sharon Steel Corp. over the experimental years, a special hot-rolled bar specification was established to match the capabilities of the envisioned techniques for forming and metals joining.

In producing grating, 1/8-inch thick steel bars up to 10½ feet in length and from ½ to 1 inch in width are first passed through a Pangborn Corp. unit to remove scale and rust. The bars are then run through a Bustin-engineered machine that serrates one edge and are subsequently fed into a gravity chute feeder at the head of the automatic forming machine.

A guillotine-type chopper peels off bars one at a time from the inclined feeder and pushes them into receptacles mounted on a series of parallel conveyor chains, *Fig.* 2. Successive indexes of the conveyor chains convey the bars to a predetermined position where they are picked up, two at a time, by an overhead handling mechanism consisting of a double series of cylinder-actuated mechanical fingers. The handling mechanism is one of three similar devices mounted on a transfer assembly that successively transfers bars, two at a time, from the indexing conveyor, through two forming operations, and onto

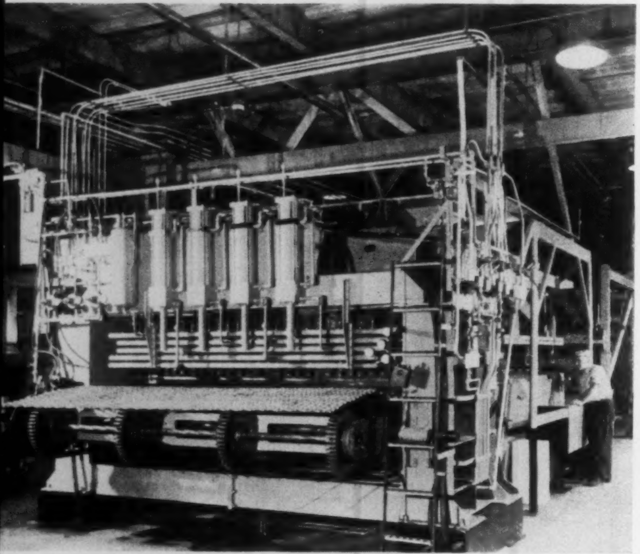


Fig. 1—Special equipment developed by Bustin Steel Products Inc. is capable of automatically producing steel grating from individual bars. Photograph is taken from outlet end of the approximately 45-foot long system which is operated by one man.

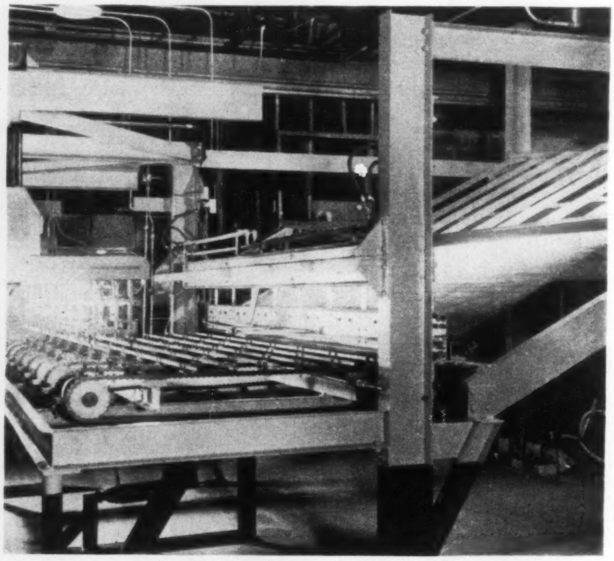


Fig. 2—Cleaned and serrated bars are held on inclined feeder ahead of indexing chain conveyor arrangement. Individual bars are fed to spaced receptacles on the chain and then moved to a position where bars can be picked up by an overhead transfer assembly.

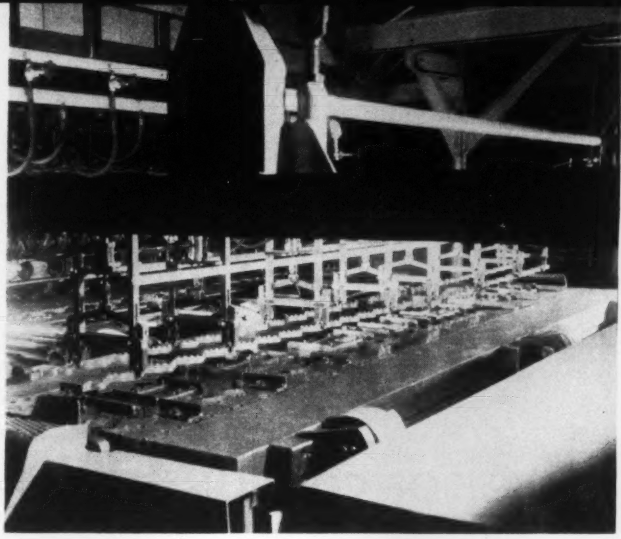


Fig. 3—The transfer assembly successively moves a pair of bars through two forming operations. Here, the multiple fingered device of one of the transfer mechanisms mounted on the overhead assembly is shown removing a pair of bars from the final forming dies for transfer to a table ahead of the welding machine.

an indexing table ahead of the welding machine.

In an initial corrugation forming operation, the two bars are preformed by lateral dies that progressively shape the bars from one end of their length to the other. The progressive action minimizes stress formations in the metal as a corrugated form is imparted to the bar.

After preforming, the second set of mechanisms on the overhead transfer assembly grasps the two bars and moves them to the final forming dies in a dual stroke multiform press, *Fig.* 3. Here, in effect, corrugations are added to corrugations, resulting in a form that enables grating to be produced. The dies in this stage can be changed to obtain different forms of grating.

From final forming, the third set of mechanisms on the overhead assembly lifts the bars and conveys them to an indexing table ahead of the welding operation, *Fig.* 4. Here, the bars are moved forward one at a time beneath a welding head which includes 28 sets of pincher type welding guns. Hydraulic pressure clamps a corrugated bar to the one which preceded it into the welder, and automatically timed current fuses the bars together at the contact points. As successive bars are fed into the welder, the completed grating is indexed out of the machine, *Fig.* 5. In normal operation, movement of a bar from the inclined feeder through the welder takes approximately 7 seconds.

The finished grating is manufactured in standard lengths. Desired widths of from 6 to 48 inches are automatically obtained by interrupting the welding cycle through the over-riding control action of automatic reset counters. The firing sequence of the 28 guns on the 700-kva welder is also adjustable to meet a variety of job requirements. All guns can be fired together, in series of threes and fours, or alternately as is desired.

From the welding machine, the panels of grating pass to a paint dip, and thence into an oven where they are baked at 350 F for 3 minutes. Painted panels are then carried by conveyor belt either to the shipping department or to an area where additional custom work is performed.

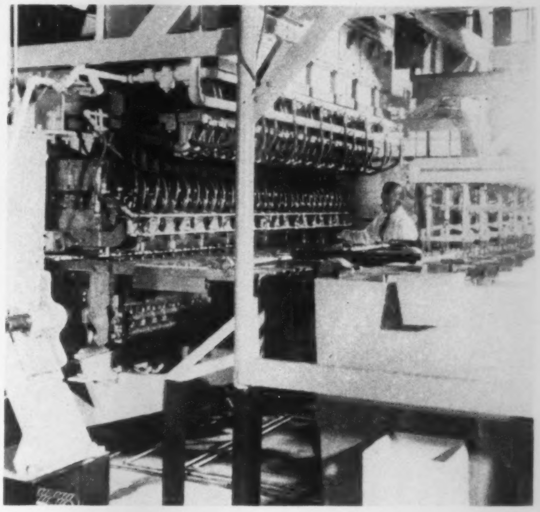


Fig. 4—Individual bars are moved beneath the welding station and clamped to previously welded bars by a series of hydraulic clamps. Successive corrugated bars touch each other at 28 points. Welding current is passed through the bars at the points of contact, fusing them together to form grating.

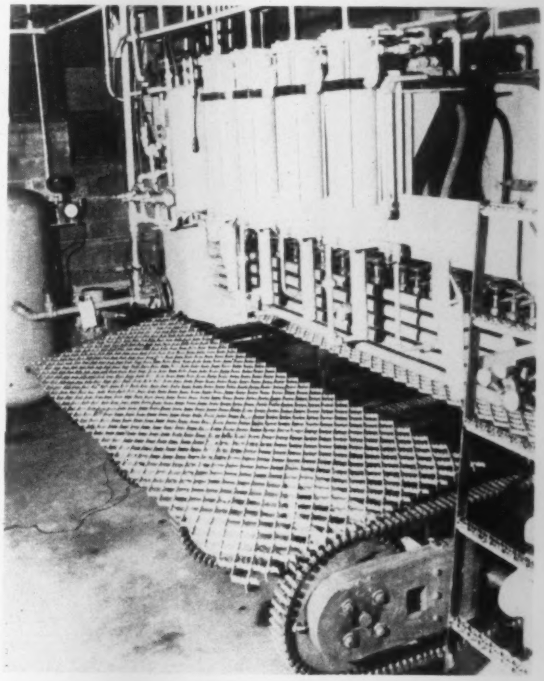
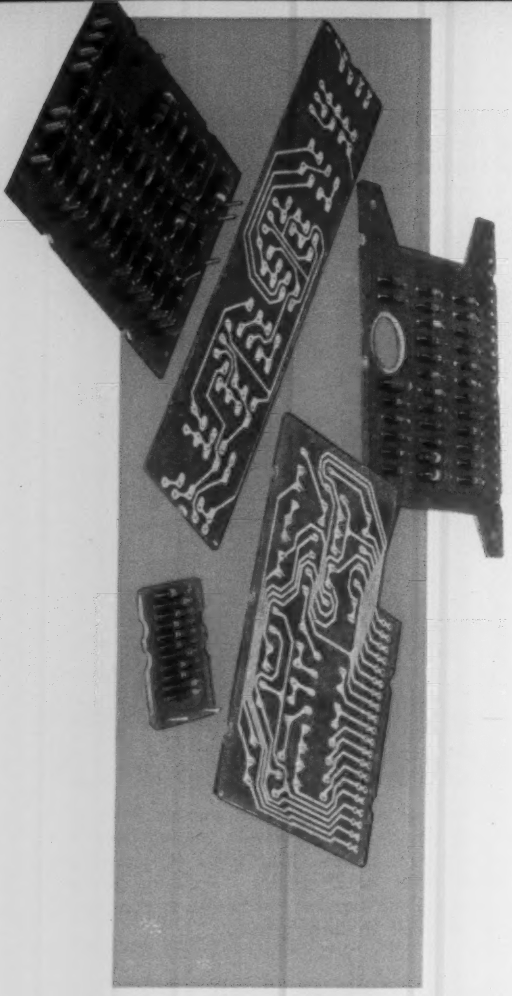


Fig. 5—Desired widths for standard lengths of grating panel are automatically created by interrupting the welding cycle. From the welder, the panels are conveyed to a painting operation.



CARDS CONTROL ASSEMBLY

OF COMPONENTS TO CIRCUIT BOARDS

Use of special, multistation assembly machines often cannot be economically justified due to low product volume. However, volume may be sufficient to justify versatile, general-purpose equipment such as the circuit board assembly machine described by the authors. In this machine components are automatically selected from a supply of 24 types and assembled at programmed positions on the boards.

By A. A. LAWSON, J. A. HOHOS, and R. TAYNTON
Melpar Inc., Falls Church, Va.

Versatility and efficiency were prime design objectives of a new machine to assemble electronic components to printed circuit boards, *Fig.* 1. Basically, this machine is built around a single inserting head which is selectively supplied with components from 24 supply hoppers. Programmed feeding of the components is controlled by a punched card. Printed circuit boards are automatically fed and positioned under the head. Positioning of the board along two axes is also controlled by the punched card.

To assemble boards automatically with this machine, an operator uses a card punching device, *Fig.* 2, to prepare a programming card. After the board magazine, *Fig.* 3, and the component hoppers, *Fig.* 4, are loaded, the card is inserted in the card reader on the control console. Boards are automatically transported from the board magazine and are positioned by pneumatic servos and tabulator stops. One component at a time is selected automatically from the component storage system and is dropped into an air track, *Fig.* 5. It then is propelled to the insertion head where the component leads are bent and directed through holes in the boards. A heated anvil below the board, *Fig.* 6, staples and solders the leads to the circuit, completing the insertion cycle in about three seconds. A board of average size, containing about 30 components, requires about 20 minutes for hand assembly. It is assembled in about 1.5 minutes with this machine.

This assembly equipment was developed for the Mini-Mech system of the Department of the Navy, Bureau of Ships, by Melpar Inc. Present equipment represents improvements on previous developments*. It is especially designed to fill the need for a facility capable of utilization for low to intermediate quantity production in a production shop or development laboratory. The machine is economically adaptable for short runs of as few as 10 boards under punched card control, and will process single boards under manual pushbutton control.

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*See A. A. Lawson — "Insertion of Electronic Components," AUTOMATION, Vol. 3, No. 10, Oct. 1956, p. 68.

▶ Board Feeding and Positioning

A major feature of this equipment is its ability to automatically assemble as many as 24 types of components to a wide variety of board sizes. The circuit board magazine, *Fig.* 3, is adjustable for board widths from 1.6 to 9.6 inches, in increments of tenths of an inch. However, automatic positioning in one pass under the insertion head is limited to an area 4.8 inches wide. Wider boards must be manually turned and reloaded. Boards to be fed by the magazine can be 2.1, 4.2, or 6.3 inches long. When the magazine is removed, boards of unrestricted length can be processed through the machine. Simple pushbutton latches on the circuit board magazine and on the positioning device facilitate quick adjustment for different board sizes.

Boards to be used in this machine have circular notches cut out of both sides at 2.1-inch intervals along the length of the boards. The circuit board magazine is a simple device providing two rows of vertical rods between which boards can be stacked with the rods engaging the detent notches. The stack of boards in the magazine is controlled by rubber pads gripping the next-to-the-bottom board. On a signal from the control console, the bottom board is dropped for advance to the positioning assembly. The board is then indexed in 2.1-inch increments by three transfer devices until it has been ejected from the magazine. The absence of a board on the slide is sensed by the third transfer device, which engages cams to drop a new board to the slide.

The circuit board positioning assembly performs two functions: 1. It transports boards from the magazine to the inserting station. 2. It accurately positions the board for the insertion of components. Boards are advanced through the positioning assembly in 2.1-inch increments by the action of the three transfer devices. Spring loaded balls engage the detents in each circuit board and hold it firmly and accurately in the positioning assembly during its travel and the insertion of components.

The positioning assembly moves the board into position under the inserting head by controlled motions along two horizontal axes. Seven equally spaced positions are available in each 2.1-inch increment of travel from left to right across the machine. In other words, seven components can be placed in each 2.1-inch segment along the length of the board. The positioning assembly is moved to one of its seven positions along this axis of motion by a special pneumatic servo system. Basis for this system is a double-end air cylinder with pressure applied to both sides of the piston. Seven exhaust ports are located along the wall of the cylinder so that when the piston covers one of these ports it is in one of its seven positions. Each exhaust port is selectively controlled by an individual solenoid valve. When one of these valves is opened, the differential pressure created on the piston causes it to move until it blocks off the open port. The positioning assembly is then locked on this axis of motion by the operation of a small

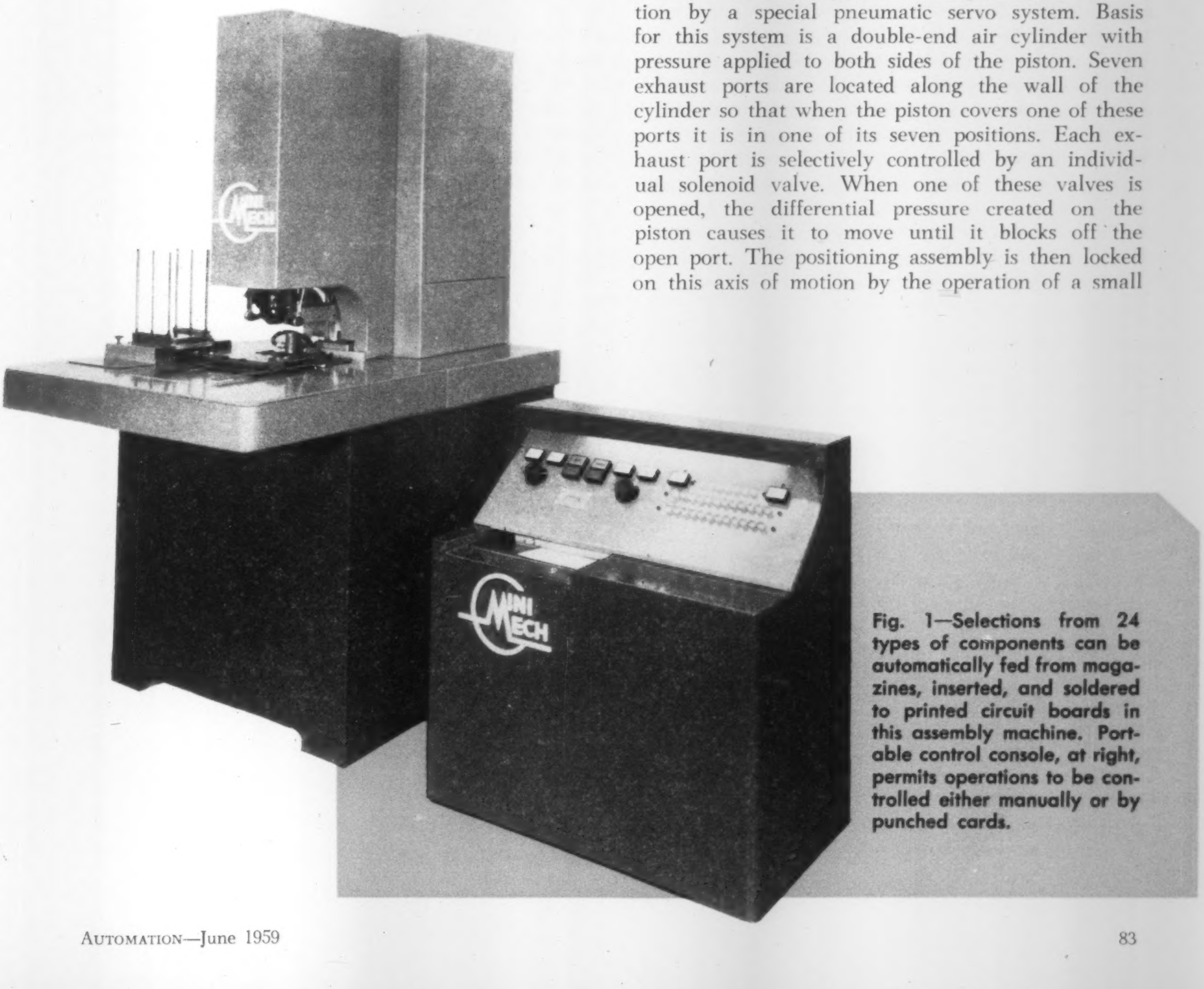


Fig. 1—Selections from 24 types of components can be automatically fed from magazines, inserted, and soldered to printed circuit boards in this assembly machine. Portable control console, at right, permits operations to be controlled either manually or by punched cards.

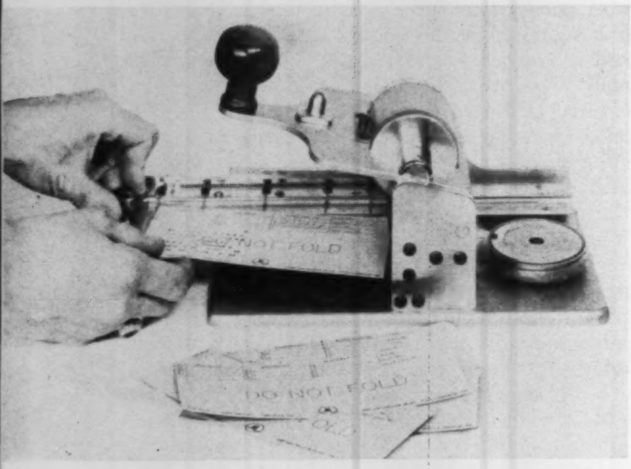


Fig. 2—Simple hand operated punch has been developed to punch program cards for the insertion machine. Instructions for individual insertion specify what component is to be fed and its position on the board.

air cylinder that advances a tapered pin down into one of seven accurately positioned holes.

Motion of the positioning assembly from back to front on the machine (across the width of the board) is accomplished by another air cylinder. Positions along this axis of motion are reached by advance of the air cylinder until a tabulator stop arrests it. Tabulator stops are available for 0.1-inch increments along this axis. Since the leads of components are bent to a 0.9-inch lead spacing and 0.3-inch space is left at each side of the board, the usual 4.8-inch board provides 34 possible positions across the board. In a single line across one such board a maximum of four components can be inserted with 0.2-inch clearance between components.

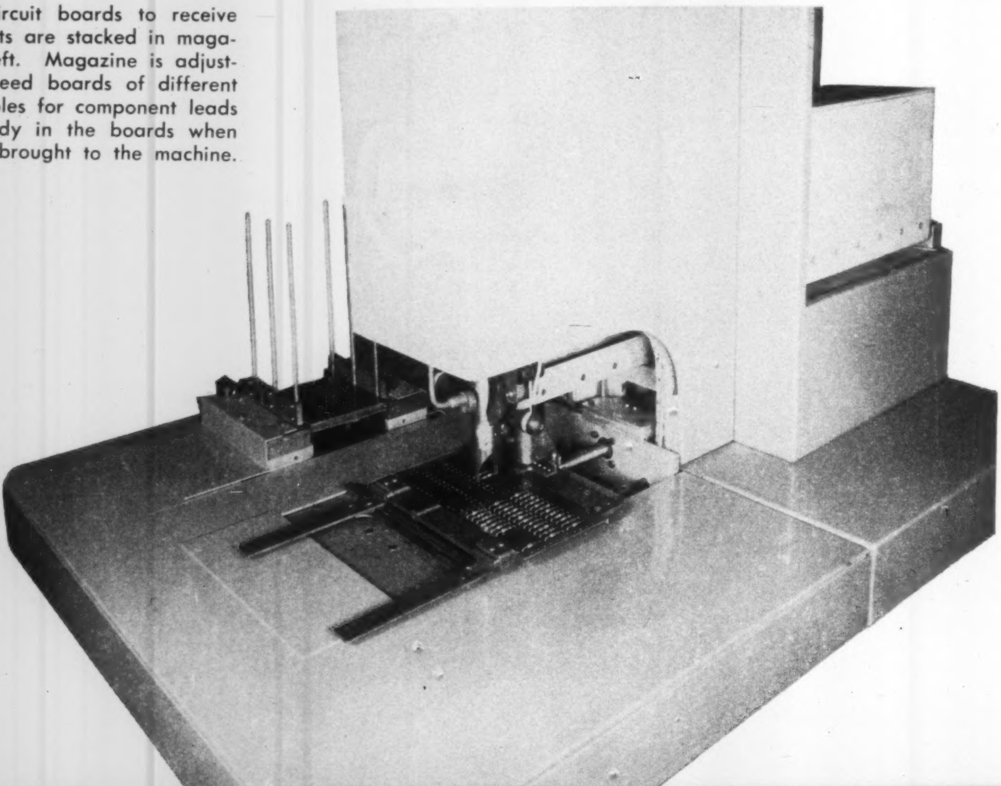
The board is successively repositioned and components inserted until all components are placed within the 2.1-inch increment of length. Then the positioning assembly returns to its home position, the board is indexed 2.1 inches, and components inserted in programmed locations. When all components for a board have been inserted, the positioning assembly returns to its home position and receives a new board. This ejects the completed board and begins a new cycle of component insertions.

▶ Component Supply and Insertion

Components are stored in magazines hung on four hinged frames, 6 magazines per frame, *Fig.* 4. Release of components from each magazine is controlled by individual electromagnetically operated gates contained in the frames. The magazines can be speedily removed from the frames for reloading or for changeover to different components. Snap latches on the swing-out frames and simple clips holding component magazines allow the entire 24 magazines to be removed and replaced in approximately three minutes.

All magazines are basically similar and vary only for the size of component they carry. All components must have axial leads and can be either round or rectangular in cross section. Magazines carry 160 components that are the size of a ½

Fig. 3—Circuit boards to receive components are stacked in magazine at left. Magazine is adjustable to feed boards of different sizes. Holes for component leads are already in the boards when they are brought to the machine.



watt resistor, and approximately half of this quantity when components are the size of one watt resistors.

When a signal from the control console actuates the electromagnet to release a component from a selected magazine, the component is dropped into a V-track. The component is propelled to the insertion unit by air jets in the bottom of the V-track, *Fig.* 5.

The component insertion unit, *Fig.* 6, consists of an air-operated head which brings the component down to a forming block and bends its leads during the travel. The insertion cycle is set into motion when a component reaches the forming block and its presence is sensed by a photocell. The forming block then swings away, and the insertion head brings the component downward until its leads are about to enter the holes in the printed board. At this point, a hold-down tool, contained within the insertion head and operated by a separate air cylinder, delivers the component to the board with its leads projecting through the holes.

When the insertion cylinder reaches the end of its downward stroke, the upward travel of an air-actuated clinching anvil below the circuit board is initiated.. As the anvil moves upward, a cam causes a pair of wipers to strike the projecting leads of the component and bend them partially to insure proper clinching against the circuit board by the anvil. The wipers are used to partially bend the leads so that outward spring of small-diameter leads, or burrs on the ends of the leads, will not cause incorrect bending of the leads and stapling to the board with leads pointing in undesired directions. The inserting head can staple any component lead whose diameter falls within a range of 0.015 to 0.043 inch.

Mechanical and electrical interlocks assure proper sequence during the insertion cycle and maintain synchronization of the operation within the entire machine. The insertion operation, although originally designed to handle components within the size range of $1/8$ inch diameter by $3/8$ inch long to 7/32 inch diameter by 9/16 inch long, is now utilized to insert components as small as a bare wire jumper.

Point soldering of components to the printed circuit, during the inserting cycle, is used to provide reliable soldered joints. An electric heating element in the base of the anvil maintains the anvil at a temperature of 580 to 620 F. While it is clinching the component leads, the heated anvil flows electroplated solder on the foil-clad board. With complete control of time, temperature, and amount of solder, a reliably soldered joint is obtained. This controlled soldering technique, plus the use of the hold-down tool as a heat sink, permits heat sensitive components such as capacitors or diodes to be safely soldered. Components can also be inserted on both sides of the board if it is loaded into the machine manually for the second side. The total time for the insertion and assembly of a component is 1.84 seconds, including 1.15 seconds of dwell time for soldering.

▶ Machine Control

The control console is a separate unit mounted on casters for portability and provides either complete manual control of the production facility through the use of pushbuttons or automatic control through use of a punched card reader. When not in use, the console fits into the rear of the inserting machine. In the stored condition, the complete facility—inserting machine, control console, and card punch—occupies about six square feet of floor space and stands about 5 feet high. Included on the front panel of the control console are two selector switches. One selects between operation of the machine or test of the console or card and the other, between manual or automatic operation of the machine. Also included on the panel are switches marked *A* through *G* that correspond to the seven insertion positions of the air servo positioning device, and switches marked 1 through 24 that correspond to the 24 component hoppers. A switch marked *Transfer* can manually actuate the tabulator indexing device in the machine, and a switch marked *Start* serves the dual purpose of either initiating the action of the card reader or setting the insertion machine in motion to perform the operation set up on the manual control panel.

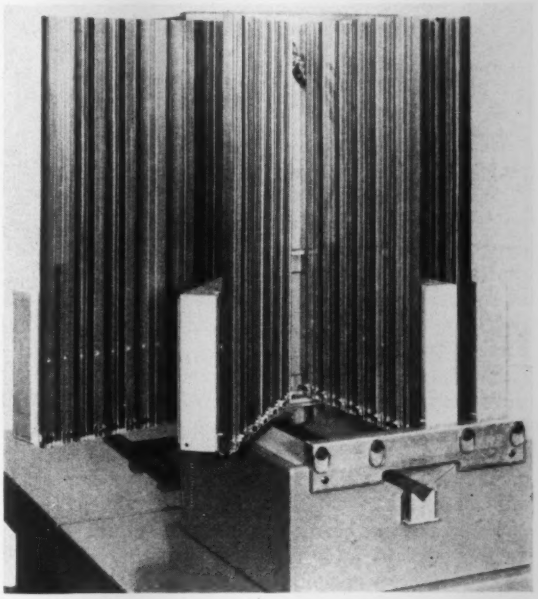


Fig. 4—Components to be fed are brought to the machine in removable magazines. Six of these magazines are supported by each of four swinging frames which provide speedy access to the magazines. Before the machine is operated, frames and magazines are moved to positions above a central V-track so that components from any of the 24 magazines can be released to the track.

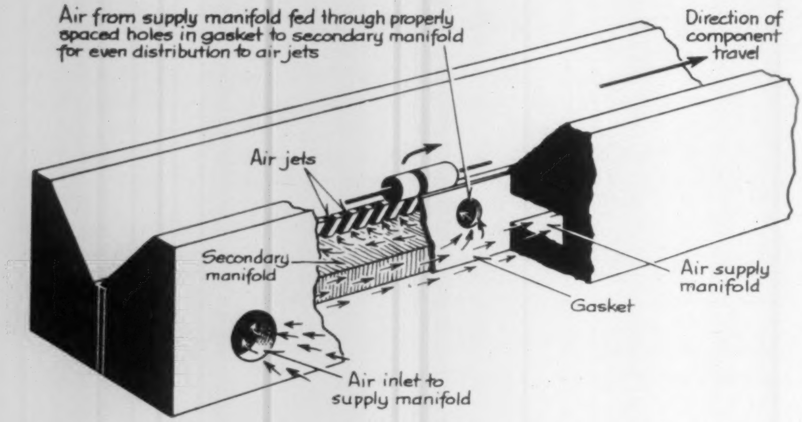

Air from supply manifold fed through properly spaced holes in gasket to secondary manifold for even distribution to air jets
Direction of component travel
Air jets
Secondary manifold
Air supply manifold
Gasket
Air inlet to supply manifold

Fig. 5—V-track under the component magazines is an air slide arrangement that transports the components to the inserting unit. Controlled air jets propel one component at a time along the track.

Instructions for automatic cycling are recorded on punched cards. A simple hand-operated punch, *Fig.* 2, was developed to prepare the cards. A binary code is used in recording the column of holes that designate the magazine to supply the component, the desired one of seven lengthwise positions, steps to succeeding tabulator stops across the board, and recycling of the card reader for a succeeding circuit board. The operation of punching a card for a circuit board carrying 33 components takes about three minutes and can be accomplished using information from engineering drawings.

Each of the switches on the manual control panel will light on signal and thus serve as a readout to determine that a card has been properly punched. By removing the cables from the console to the machine and setting *Automatic* and *Test* on the selector switches, a card may be checked by inserting it into the card reader and pressing the *Start* switch. Each line of punched holes on the card will be successively decoded and displayed on the manual control panel.

With components and boards ready to feed, tabulator stops set, control cables replaced, the console switched to *Operate*, and the checked card in position, the console will automatically control the complete cycle of insertions. Card reading is set in motion by depressing the *Start* switch. The card reader sends a signal to the machine for the first operation. Upon completion of the insertion operation, the insertion unit transmits a signal back to the console and the card reader is reset to read the next operation. In this manner, the two units are interlocked so that one operation does not overlap the next. If an operation is not completed, the entire equipment is automatically stopped.

Another feature of the control system is an arrangement to selectively control the height of components above the surface of the circuit board. Mainly this is used to compensate for the variation in diameters of different types of components being inserted. This adjustment is automatically obtained by using a tabulator stop arrangement on the stroke of the hold-down tool. A stop for the particular component being inserted is set in accordance with a signal from the magazine from which the component was selected.

The positioning and control ideas applied in this equipment are, of course, not limited to this particular machine configuration. In fact, thought has been given to their application for operations on miniature electronic elements where increments of motion are required in thousandths of an inch. In addition, they can also be applied to problems in industries besides electronic gear manufacturing.

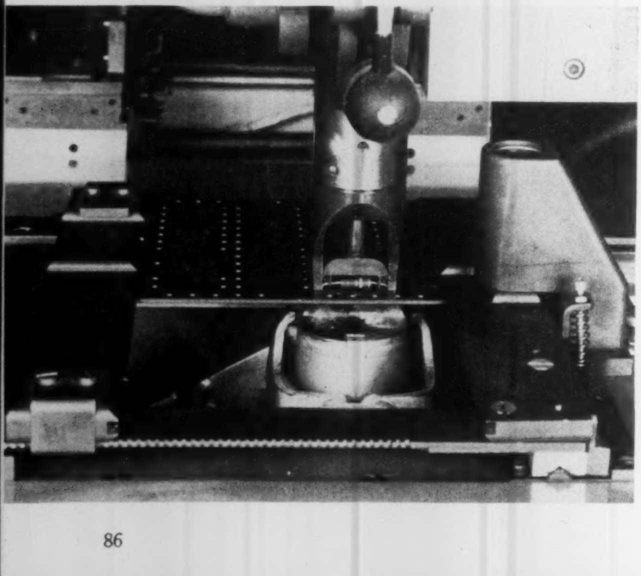


Fig. 6—The insertion unit above the circuit board receives components via the air slide, forms their leads, and advances them down to the board. A separate hold-down tool then holds the component at prescribed height while a heated anvil rises below the board, bends the leads against the underside of the board, and solders them in place.

RIVETING IS MODERN

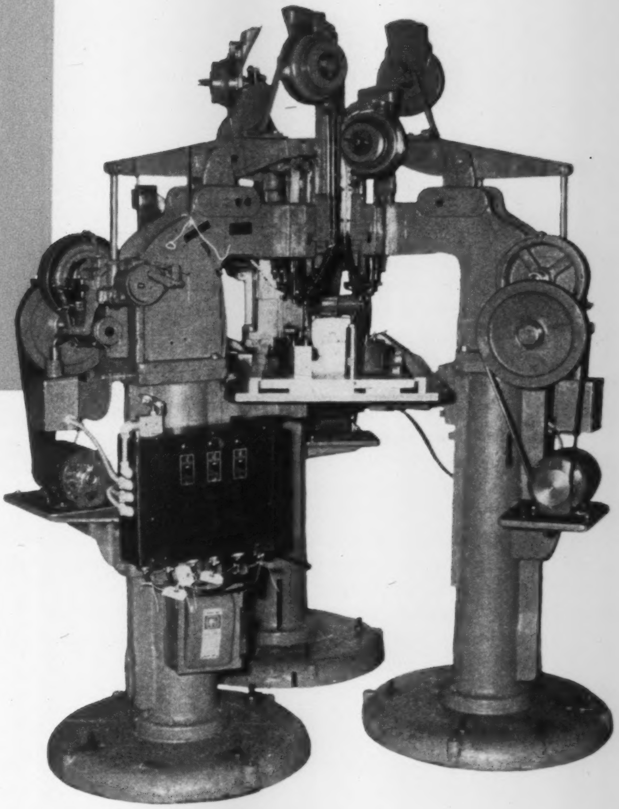


Fig. 1—Casters are fastened to canister-type vacuum cleaner base at General Electric Co. plant with this Judson L. Thomson Mfg. Co. multiple rivet machine arrangement. Operator loads parts onto fixture which then slides into setting position beneath riveting heads. After rivets are automatically set, fixture returns to unload position.

By RALPH S. BATTLES
President, Judson L. Thomson Mfg. Co.
Waltham, Mass.

AS A POPULAR CONCEPT, the term "automation" is most familiarly applied to the processes that have followed the rapid advances made in new production machinery. But as a technical concept, the term can be applied to mechanized processes, regardless of age, that satisfy today's exacting requirements of economic performance. To those most concerned with cost factors, design considerations, and production problems, automation involves many basic tools applied in many varied but proved ways.

Increased interest of production engineers in automatic assembly techniques has led to the "rediscovery" of riveting—a proved assembly method that grew into prominence when harness making was a major business. Analysis has shown that with today's improved equipment, controls, and concepts, riveting can be a convincing answer to the problem of reducing assembly costs in a wide variety of industries.

Riveting machinery is at an advanced stage of development in the critical area of automatically orienting, feeding, and actually setting the rivet. With handling of rivets an accomplished art, an important part of the problem of automatic assem-

Factors Contributing to a Renewed Interest in Riveting

- Automatic setting machines are readily adaptable to modern production requirements.
- Range of types, head styles, materials, and finishes of rivets affords the engineer an unusual opportunity to achieve an optimum design at no sacrifice to producibility.
- Certain types of rivets can serve a dual function in an assembly. For example, a shouldered rivet can serve as both a fastener and a pivot in an assembly. In electrical assemblies, head of rivet fastener can serve as an electrical contact.
- Method of setting rivets is compatible with assembly requirements where thin gage metals, plastics, and dissimiliar materials are used in products.
- Rivets are relatively inexpensive fasteners.

bly involving rivets has already been solved. In addition to the familiar technique of feeding and setting a single rivet, techniques are available for automatically feeding fastener elements to both sides of an assembly point and mating the two elements together.

▶ Modern Machines

As regards the use of riveting machines, the situation is similar to that faced by machine tool users. With critical study, it has become apparent that inherent capabilities of standard, manually operated machine tools exceed the use to which they can be put because of such limiting factors as manual load and unload of the workpiece. Significant advances are made by upgrading the nonproductive handling phase of a work cycle.

Modern rivet setting machines will set rivets as fast as the machines are manually tripped. Actual production speed, however, depends on how fast components can be assembled and positioned at the machine. To accelerate assembly and speed up production, riveting machines can be equipped with special work handling and loading devices, radial or turret feeds, and other accessories, *Fig.* 1 and 2. When production warrants, riveting equipment can be adapted to in-line machine arrangements, *Fig.* 3.

Typically, automated assembly machines fall into the "special" category and here modern users of rivets benefit from established practices of the riveting industry. In their dual capacity of producing both fasteners and setting machinery, rivet manufacturers have traditionally assumed a responsible role in helping users solve special engineering problems for all phases of rivet assembly.

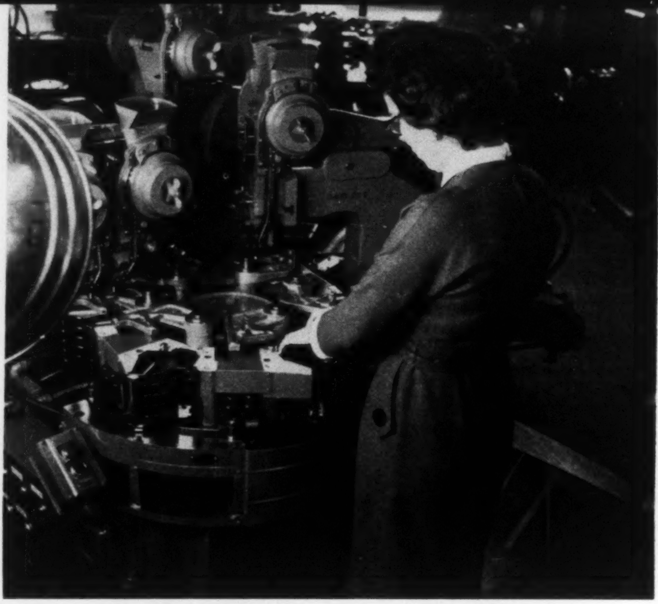


Fig. 2—Multistation riveting machines can be created by combining setting equipment, dial index tables, and suitable fixtures. Finished parts are automatically ejected, allowing operator to confine attention to loading of parts to be assembled.

▶ Feeding and Setting

Automatic hopper feeds on riveting machines provide for a simple but positive delivery of rivets from a bulk supply in a hopper to the point of application. The general problem involves selecting and orienting single rivets taken from a bulk quantity; holding the orientation as the rivets feed to the application point; placing individual rivets into driving position; and setting the rivet.

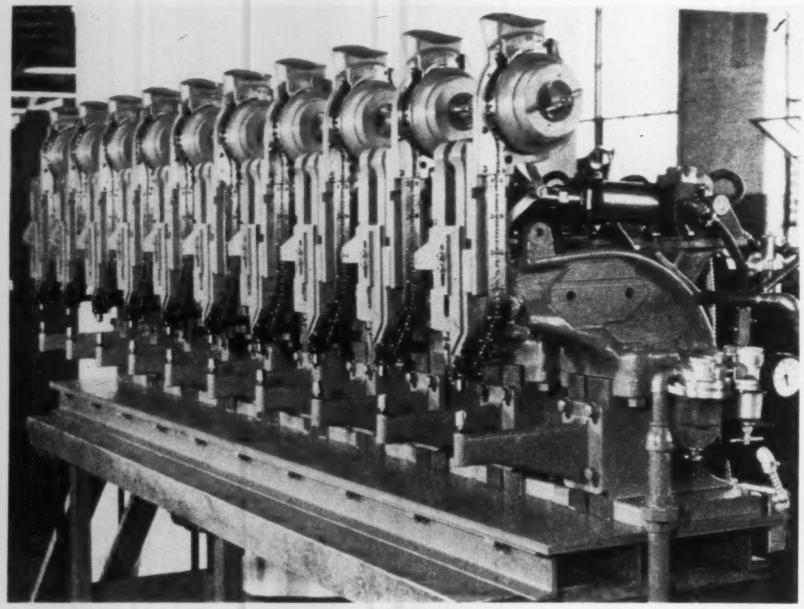


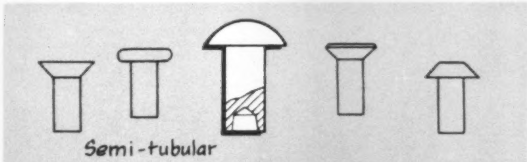
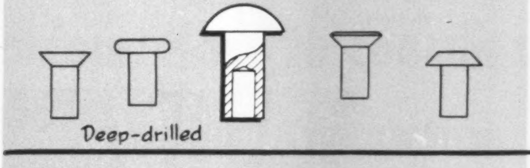
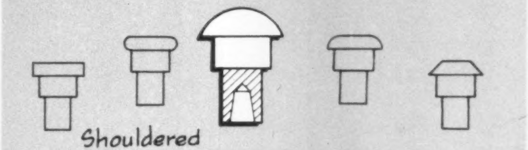
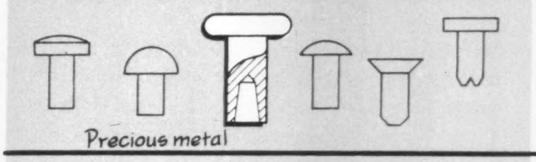
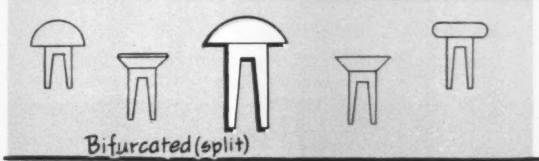
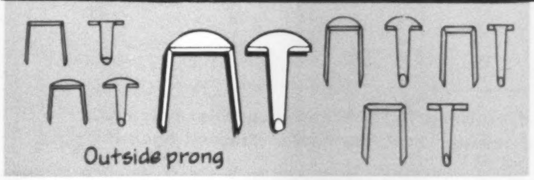
Fig. 3—Example of in-line arrangement of bench type riveting machines is shown. Equipment is designed to be placed alongside conveyor that provides for automatic transfer of workpieces to be assembled.

In the hopper assembly shown in *Fig.* 4, a gap, determined by the head thickness of the rivet to be used, is formed between a rotatable hopper ring and a stationary back plate. The hopper ring is slotted according to the body diameter of the rivet. Bulk rivets are placed in the hopper assembly and agitated as the hopper ring rotates. Constant agitation correctly orients some of the rivets and they drop through the slots with the head end in the gap. Located on one side of the hopper assembly and on a tangent to the hopper ring is a feed track that is designed to retain the orientation of the rivet. As the slot containing a rivet reaches the point of tangency, the rivet falls from the hopper into the tracks and down to a point at which the feed track is offset and blocked by a release mechanism.

The release mechanism, a slotted reciprocating member that moves laterally, automatically feeds one rivet at a time from the feed track to a short track section leading to a pocket formed by mating two parts, each of which contains a specially contoured cavity. The resulting hole in the pocket assembly formed by the cavities contains a step that holds the rivet in place, preventing it from dropping through. Both halves of the pockets are held together by spring sides. The rivet is now in position to be driven through the work.

The stem, or upper anvil, which is ground to fit the head shape, then moves downward and engages the rivet head, steadying the rivet in the pocket. The stem and pocket continue the downward travel until either the hole in the rivet (if present) seats on a pilot or the rivet contacts the work. At this predetermined setting, the stem continues downward, driving the rivet out of the pocket, through the work, and onto the lower anvil where the clinch is formed. Where brittle materials,

TABLE 1—Rivet Styles

Standard Head Shapes	Description and Function
 Semi-tubular	Shallow hole, extruded or drilled in shank, does not exceed shank diameter. Used to join metal, wood, plastics, and other hard materials through predrilled or prepunched holes.
 Deep-drilled	Hole, drilled to a depth exceeding shank diameter, converts rivet into punch which compresses materials within hollow shank. Used to assemble plastics, soft woods, fabrics, and other easily pierced materials.
 Shouldered	Cold-formed or cold-headed and turned to obtain shape. Used when fasteners can provide bearing surface for free motion within joined members.
 Precious metal	Formed from wide range of special contact alloys. Used to obtain reliable contacts with higher-than-usual electrical conductivity or resistance to corrosion.
 Bifurcated (split)	Slot milled in shank forms two sharp prongs that can pierce material. Used for assembling light gage metals, as well as heavy and light sections of leather, fibreboard, wood, and plastics.
 Outside prong	Formed from sheet metal to obtain domed or flat heads and two projecting prongs. Used to fasten fibreboard, leather, fabric, cardboard, and similar material.

such as glass or ceramics, comprise part of the work being assembled, the riveting machine may be air driven and provided with a back pressure control valve to accurately limit the clinching pressure.

Several types of lower anvils are available for clinching tubular rivets. Either a roll clinch or a scored clinch is formed. Generally, a solid anvil is used with a rivet that is self piercing. For work location involving prepunched holes, anvils can be provided with pilot pins that recede into the body of the anvil during a setting operation.

Various types of clinches are shown in *Fig.* 5. Viewed from bottom of assembly, *Fig.* 5*a* indicates rolled and scored clinches that can be applied to semitubular and deep drilled rivets. *Fig.* 5*b* indicates common variations in the clinching of rivets with prong-type shanks. Where a finished appearance is required on both sides of the assembly, it is obtained by one of the methods shown in *Fig.* 5c. Compression rivets for this use are formed by pairing a precision-made deep drilled rivet with a solid rivet. Chamfered shank of the solid rivet, when pressed into the hole in the drilled rivet, provides the binding force to hold predrilled parts together. Also used to obtain a stronger bearing surface, the more common rivet and cap method forms the clinch within separate caps that have the appearance of rivet heads.

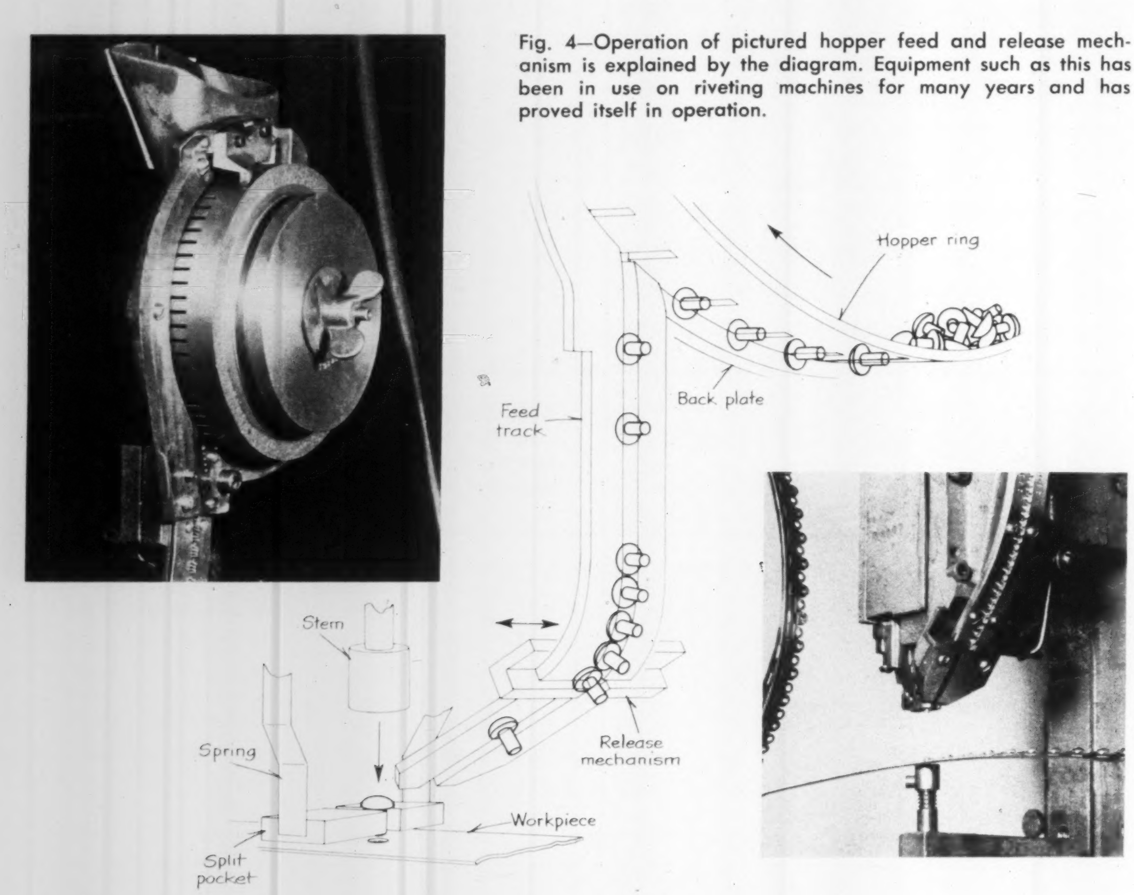

Hopper ring
Back plate
Feed track
Stem
Spring
Release mechanism
Workpiece
Split pocket

Fig. 4—Operation of pictured hopper feed and release mechanism is explained by the diagram. Equipment such as this has been in use on riveting machines for many years and has proved itself in operation.

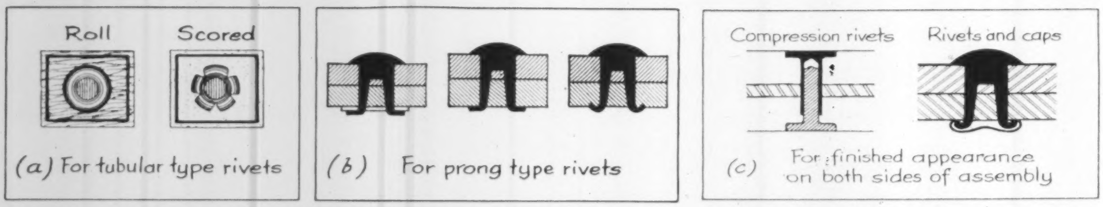
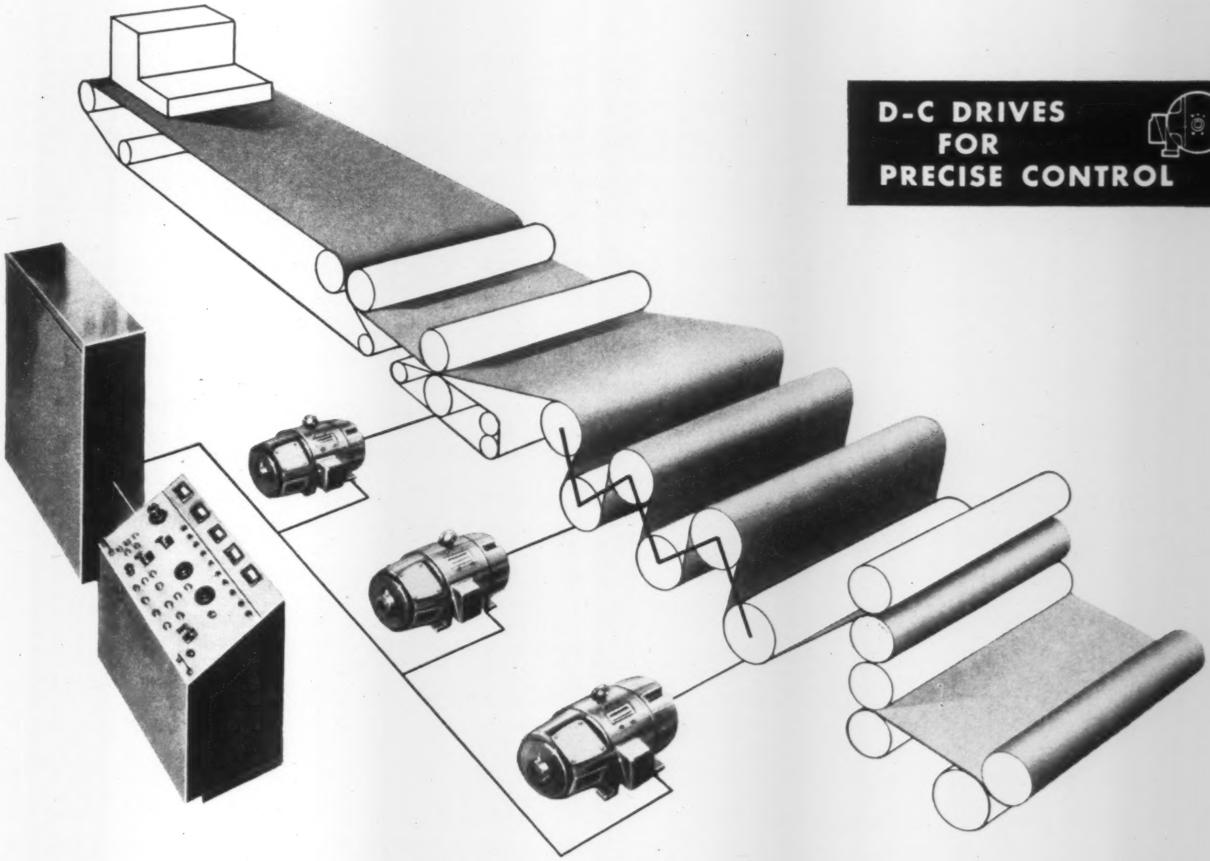

Roll
Scored
(a) For tubular type rivets
(b) For prong type rivets
Compression rivets
Rivets and caps
(c) For finished appearance on both sides of assembly

Fig. 5—Sketches indicate various methods of clinching rivets. When a stronger bearing surface is required to prevent a clinch from tearing loose, the rivet is clinched against a washer or inside caps.



D-C DRIVES FOR PRECISE CONTROL

Problem: How to coordinate two or more machines for greater production flexibility, lower costs

Operating at high speeds, working to close tolerances, meeting high-quality standards, today's machines must be controlled accurately. This is one of the reasons users and designers are making greater use of direct-current drives for coordinating two or more machines in multi-section process lines.

MACHINE COORDINATION IS A NATURAL JOB FOR DIRECT-CURRENT POWER. For direct current can best provide the accurate speed matching and extra measure of control needed for high-speed, automatic continuous processing.

D-c's flexibility allows each individual drive motor to be run at the exact speed demanded by the section of the process it drives. Increased output, better quality control and production flexibility lower the cost per unit of production.

To learn more about the modern capabilities of direct-current power, write for your free copy of "WHY D-C?", *Section 829-3, General Electric Company, Schenectady 5, New York.*

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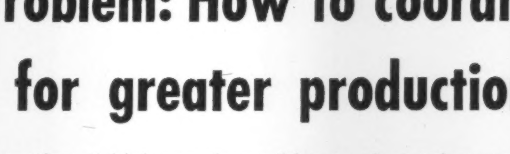

MOTORS AND GENERATORS

POWER UNITS AND CONTROLS

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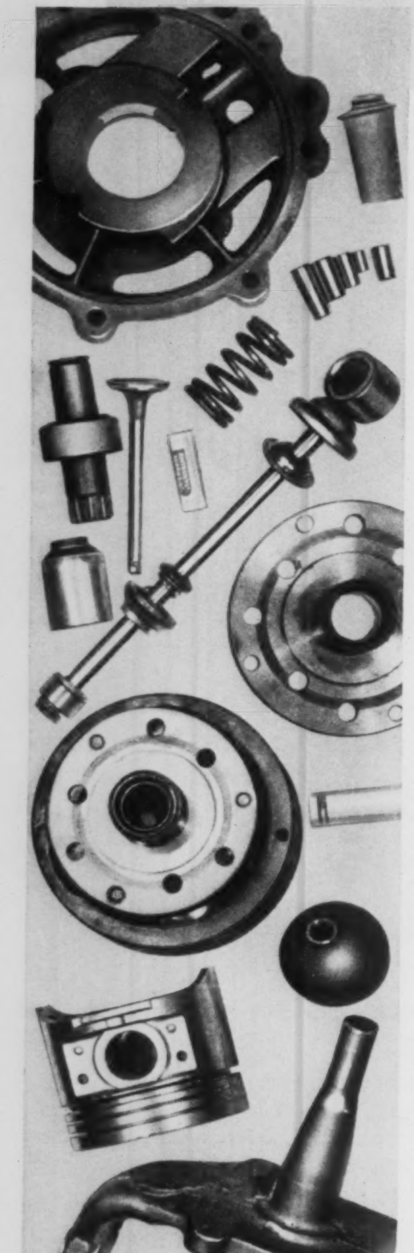
..... practical automation ideas



Portable Demand-Feed Storage

For plants operating on a job-run basis, Gear-O-Mation has recently developed a number of portable storage units which can be quickly rolled into position at various machines to provide demand feed. One such unit has storage 'containers' for several sizes of parts. An important advantage: parts are protected against damage in handling into and out of storage and at the machine.

Simple Locating Shuttle

A simple walking beam device permits the quick shuttling of large castings from one machine or line to another, locating the part in the second machine automatically in the same motion.

Gear-O-Mation Division was organized in 1956 to develop and build highly practical automation equipment GEARED TO EITHER EXISTING OR NEW PROCESSES AND MACHINES—whether already in use or new.

Automated Handling of Fragile Parts

Fragile parts can be handled between operations without danger of injury by a conveyor with removable pallets. The pallets carry the work to the proper place and then return to the starting point on a separate conveyor. A typical use: manufacture of grinding wheels.

No Electrical Units

A combination parts-accumulator, storage device and demand feeder has no electrical connections or devices. Servicing of parts elevators, escape mechanisms, sensing devices, etc., can be be done with a couple of wrenches and a screwdriver. All controls and operating units are pneumatic.

It is the policy of Gear-O-Mation to use only proven mechanical, pneumatic, hydraulic or electrical devices in its automation equipment. This minimizes chances of service interruptions and insures minimum cost consistent with reliability and performance.

"Wash Just Before Use"

Demand-feed storage units can be combined with integral parts washers in such a way that parts can be cleaned as they go into storage or just before they come out, or both. Best practice seems to be: clean parts shortly before they pass on to the next operation.

The success of Gear-O-Mation's "simplicity" policy is attested to by the successful operation of Gear-O-Mation equipment in a wide variety of industries and both continuous or job-lot types of plants.

Irregular Parts Can Roll Too

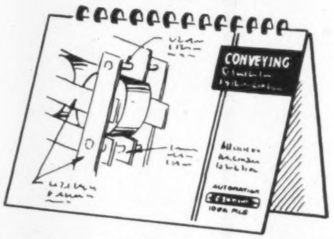
Parts that are notched and have a tendency to interlock can be fed by gravity without difficulty provided the proper chute angle is used. At Gear-O-Mation we don't depend on 'paper calculations' for this. 'Adjustable angle' gravity test chutes are used to find the best chute angle to avoid interlocking and yet feed parts at minimum rolling speed to avoid damage.

To automate you do not need to spend fortunes. Nor do you have to go in for complex electrical or electronic control. Frequently the simplest solution is the best. That's Gear-O-Mation's philosophy. Yes, we know, it often takes more ingenuity to do things simply rather than by complex devices. But that's our stock in trade—INGENUITY.

Cleaning-Up Boosts Output

Experience shows that where handling of parts is automated, the increased plant cleanliness alone tends to boost production more than would be expected from the automation alone. Some plants get increased output simply by "getting everything off the floor".

NEW "IDEA FILE"



Every Gear-O-Mation field engineer now carries with him an "Automation Idea File." It contains sketches and details of practical answers to many parts handling problems—orienting, feeding, positioning, conveying, distributing, etc. These ideas will suggest variations to suit your exact needs. Have a Gear-O-Mation field engineer go through the "Idea File" with you soon! Use the handy coupon at left.

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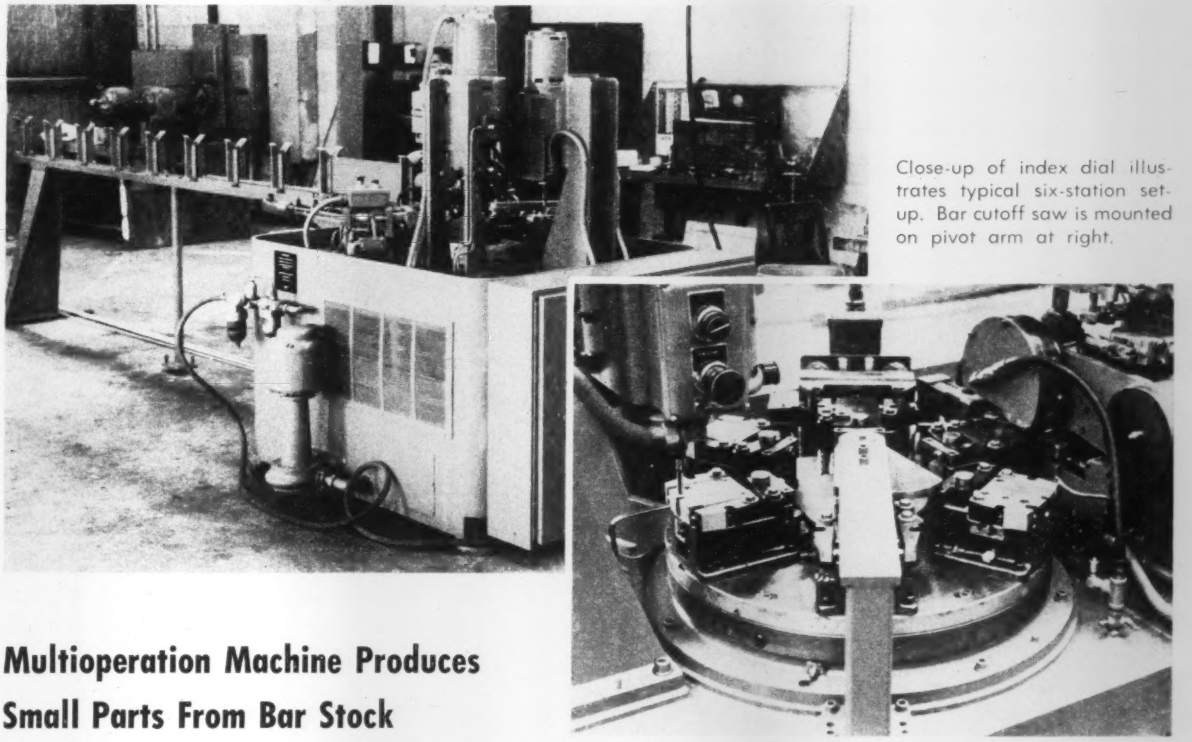
AUTOMATION new equipment

Machines and plant equipment for more automatic operations. For detailed information and literature, use card on page 17.



Close-up of index dial illustrates typical six-station setup. Bar cutoff saw is mounted on pivot arm at right.

Multioperation Machine Produces Small Parts From Bar Stock

MULTISTATION indexing machine produces small parts and components from $\frac{1}{2}$ to $1\frac{1}{2}$-inch square, round, rectangular, or hollow extruded bar stock which is fed automatically to unit. Six or more operations can be performed by the machine, designed by **Automation Development Corp.**, 135 Reynolds Rd., Mentor, Ohio. Geneva-driven index tables with 4, 6, or 8 stations are available.

In operation, stock is advanced at a cutoff station where the stock is cut off and the piece retained in a dial fixture. The fixture then indexes to subsequent stations where operations such as stamping, milling, drilling, tapping, spinning, riveting, welding, and inspecting may be performed. The finished piece is ejected at a final station. Supplementary piece parts such as screws may be assembled to the basic bar stock part when the machine is equipped with an orienting, feeding, and driving head.

A feature of the machine is its magazine loading bar feeder which automatically selects a new bar, when it is needed, from the bottom of the stack of bars in the magazine. The new bar is fed without interruption to production. The loader also rejects short bar ends automatically. Deforming of hollow extruded stock during processing is prevented by the use of a mandrel that conforms to the internal configuration of the stock.

Included in the machine is a dull tool detector. This unit is arranged to stop the machine if the load on the tools exceeds a preset value, which is an indication that a tool is dull and should be replaced.

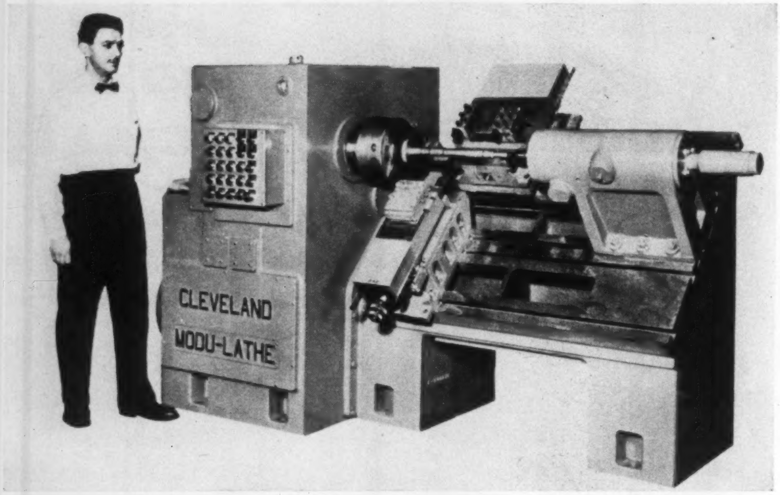
A master pushbutton station at the operator's position permits control of the entire machine. Individual pushbutton stations for each workhead allow jogging and running of individual stations for adjustment and setup purposes. Limit switches at each workstation sense that all heads are retracted before indexing can occur.

A variety of machining heads, both vertical and horizontal, can be incorporated in the machine. Output of the machine will depend upon the types of operations performed. Indexing action between operations requires only 0.4 second.

Circle 401 on Page 17

"Building-Block" Lathes and Chucking Machines

Item 402



Designed to meet customer requirements, line of lathes and chucking machines features "building-block" construction. Interchangeable components can be combined with any one of six heavy-duty headstocks and four rigid beds to fit specific applications. The headstocks are constructed of high tensile strength cast iron with a 2-inch thickness in the major walls. Turning speeds up to 5000 rpm are available. The beds are furnished in a range of sizes from a 30-inch long pedestal-type bed weighing 1500 lb to a 140-inch long bed weighing 6000 lb.

The types of machines in the line include: Pedestal lathe, face profiler, production turning lathe, stub profiler, and threading lathe. The interchangeable components include: Cross slides, profiling slides, flat and round template positioners, rocking cross slides, indexing tool posts, six-station turret, spindle indexing mechanisms, tracing controls, hydraulic tailstocks, thread cutting screws, and high speed collet assemblies. **Cleveland Hobbing & Machine Co., Div., Textron Inc.,** 1311 Chardon Rd., Cleveland 17, Ohio.

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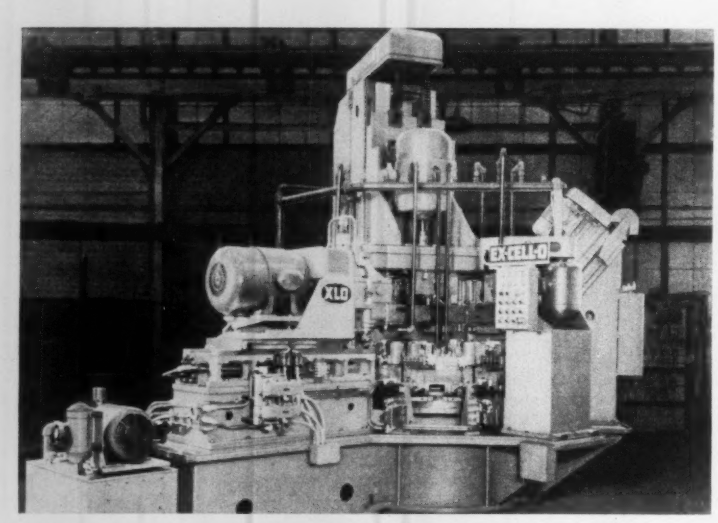

Eight-Station Rotary Index Unit

Item 403

Spot facing, milling, drilling, tapping, reaming, and core drilling operations can be performed on 8-station rotary index machine. Production rate for processing oil pump bodies is 68 pieces per hour. The machine table is arranged with a set of eight 2-position workholding fixtures. Each side of the fixture is equipped with an individual set of hydraulically operated, cam-locked clamping members and manually actuated back-up jacks to hold and support the part. The pump body is mounted in the left hand side of the fixture and cycled through the machine. Upon returning to Station 1, the part is reloaded in the right hand side of the fixture and recycled through the machine, thereby permitting machining operations on both sides of the pump body.

A shot pin locates the indexing work table. A horizontally mounted slide at Station 2 is arranged for milling the flat surfaces of the part. A vertically mounted drill head and bushing plate assembly performs a series of drilling and reaming operations at Stations 3, 4, 5, and 6. An angularly positioned unit is used to bore a cored hole at Station 7, and a vertically mounted head carries taps at Station 8. **Ex-Cell-O Corp.,** 1200 Oakman Blvd., Detroit 32, Mich.

Circle 403 on Page 17

MICRO SWITCH Precision Switches

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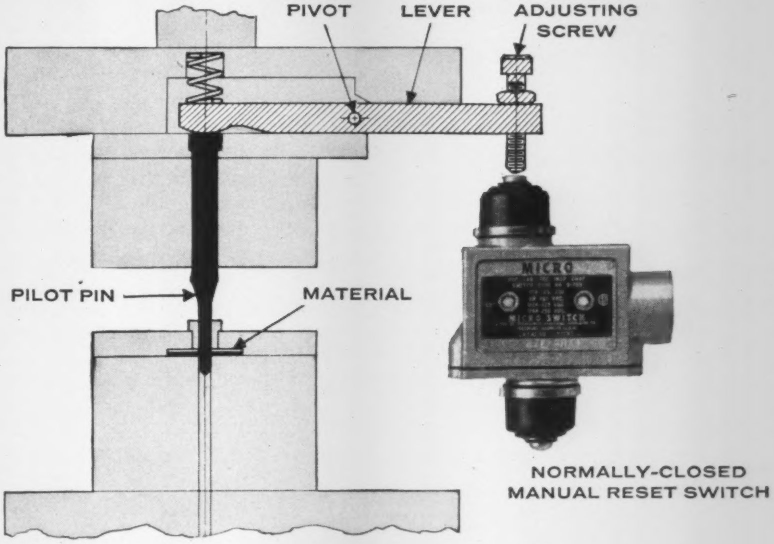
Many plant uses for precision switches

- TENSION CONTROLS
- WEIGHT CHECKS
- POSITION CONTROLS
- CARRIAGE TRAVEL CONTROLS
- COIL BUILDING CONTROLS
- SAFETY DOOR INTERLOCKS
- PUMP MOTOR CONTROLS
- THICKNESS DETECTORS
- SHEAR CONTROLS
- COUNTING DEVICES
- CONVEYOR STOPS
- PRESSURE INDICATORS
- FLOW INDICATORS
- SAFETY CONTROLS
- PAINT SPRAY CONTROLS
- PROCESS CONTROLS
- PACKAGING CONTROLS
- MOTION CONTROLS
- LEVEL CONTROLS
- AND MANY OTHERS



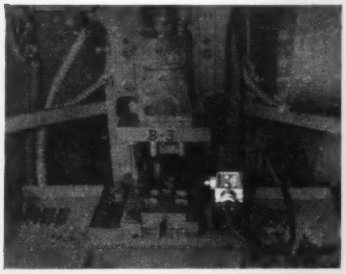
For example: This switch detects misfeed of material in progressive die

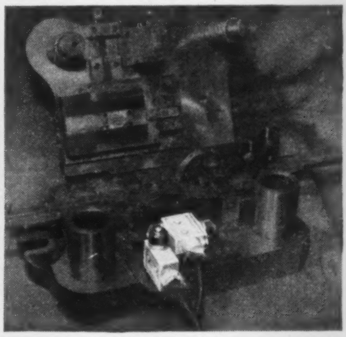
This is but one of many low-cost ways to prevent damage to tools and dies with MICRO SWITCH precision switches. In this case the switch is interlocked electrically with the punch press clutch. It stops the press before a misfeed can cause injury to the die or damage to stock.

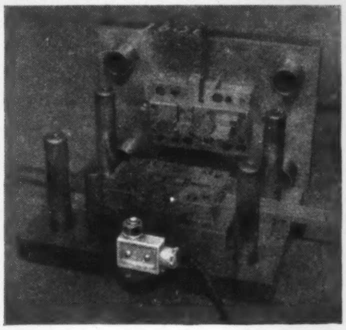
There are thousands of ways to make plant equipment more automatic, safer and more productive through the use of MICRO SWITCH precision switches. Their versatility, simple design, long-lived reliability, low initial cost and low maintenance costs add up to more profit when they are installed on existing machines.

Send for new data sheets on use of MICRO SWITCH precision switches for die protection. Stocks of switches are available at authorized distributors everywhere. Look under "Switches, Electric" in the Yellow Pages.

Some other die protection installations



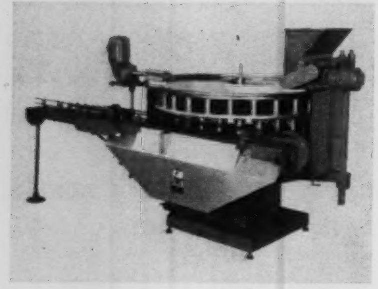




MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH Precision Switches

Circle 686 on Page 17

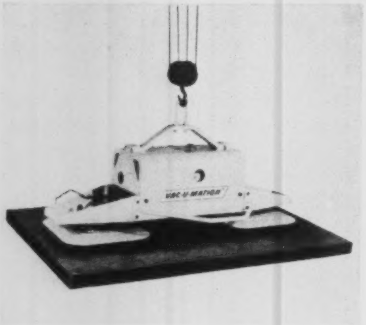


Can Filler

Item 404

Twenty-four pocket machine can fill granular free-flowing products into cans at the rate of 300 per minute for 303 by 406 cans. The types of products the machine handles include: Berries, cherries, prunes, peaches, beets, and carrots; as well as popcorn, candies, and nuts. With the addition of an automatic hopper and an adjustable brush on the filling top, the entire operation can be automatic. The telescopic filling pockets can be vertically adjusted within given ranges to control volume for various can sizes. The can feed conveyor, spiral timer, guide rails, and lug chain can also be adjusted to meet requirements of different products. Other features include: Individual pocket cut-off plates, a "no-can no-fill" device, and a straight line can travel. Unit is also available with 12 or 18 filling pockets. **Canning Machinery Div., Food Machinery & Chemical Corp.**, Box 1120, San Jose, Calif.

Circle 404 on Page 17

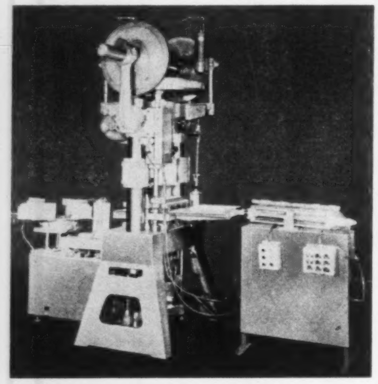


Vacuum Sheet Lifter

Item 405

Crane suspended vacuum lifter is capable of lifting and moving steel and nonferous plates weighing up to 8000 lb. Unit shown has two 20-inch square vacuum cups, each with 400 square inches of lifting surface. At 10 pounds per square inch vacuum, each cup has 4000 pounds of lifting power. A 4 to 1 safety factor gives rated capacity of 2000 pounds total. The vacuum pump is a twin cylinder, high volume, dry piston type unit which requires no oil and is capable of maintaining a vacuum of 27 inches of mercury. Pump has a displacement of 6.57 cfm and is driven by a $\frac{1}{2}$ hp, 115 v, one phase, 60-cycle motor. The motor is arranged to run periodically so that a minimum vacuum of 20 inches and a maximum of 25 inches of mercury will be maintained in the reserve tank. Other models operate from compressed air lines and require no pump. **Vac-U-Mation Div., F. J. Littell Machine Co.,** Dept. 6-A, 4127 N. Ravenswood Ave., Chicago 13, Ill.

Circle 405 on Page 17

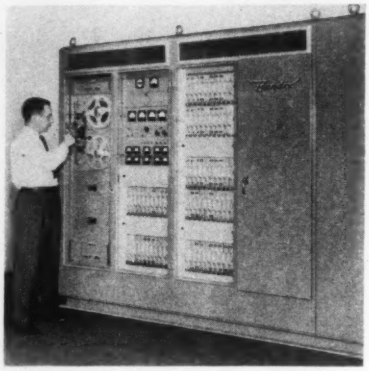


Tile Press

Item 406

Granular material is automatically fed to the press where it is sized and formed into tiles which are then ejected and stacked. Capacity of the machine is six $4\frac{1}{2}$-inch squares per cycle at 10 to 12 cycles per minute. Three other units are attached to the press: A sizer which adjusts the press to maintain the specified tile height; a controller which pushes the formed tiles to a stacker located at the rear of the press and a stacker which adjusts to any tile height and stacks the tiles on removable trays. **Crossley Machine Co.,** Trenton, N. J.

Circle 406 on Page 17



Machine Control Unit

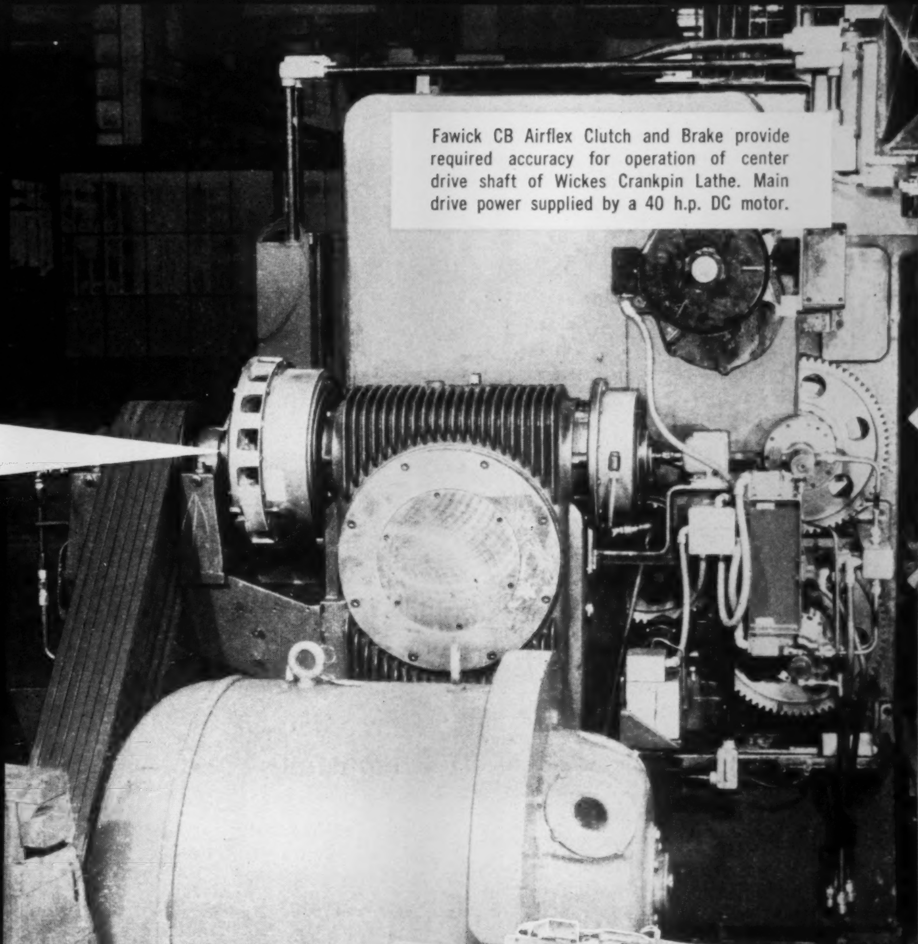
Item 407

Device can simultaneously control four independent motions of machine tools (horizontal, vertical, longitudinal, and tilt positions) to machine difficult part shapes such as engine mounts, bulkheads, airfoil contours, or any type part requiring twist type cutting operations with close tolerance. Input to the control unit is punched tape. A tape reader permits reading of 300 lines per second in the forward tape direction and 600 lines per second in the reverse direction. There is an automatic tape rewind at the end of the machining cycle. The operator is thus freed to remove the part as the tape is being rewound. There are also four decimal display position indicators (to assist in set-up operations) with continuous read-out of position location on all four axes. Four auxiliary tape control functions are available to automatically control functions such as coolant flow, spindle speed, tool changes, table indexing, and chip conveying.

In operation, the tape containing the data for machining a specific part is mounted on the tape reader of the 4-axis machine control unit. An operator positions the machine tool cutter to the setup point corresponding to the initial position on the tape, presses the *Start* button and automatic cycle begins. First, a photoelectric tape reader scans the data, checking each line to see that the tape is punched and read correctly.

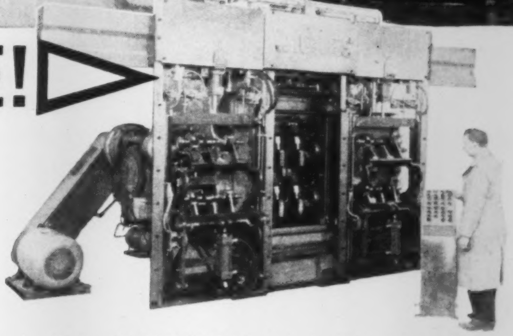
If there is an error in reading the tape while it is held in temporary storage, the control unit will stop the machine at the instant the motion of the last correct block being

Fawick Clutches here...



Fawick CB Airflex Clutch and Brake provide required accuracy for operation of center drive shaft of Wickes Crankpin Lathe. Main drive power supplied by a 40 h.p. DC motor.

help full automation HERE!



Wickes Model MX-4 Crankpin Lathe is used for automatic turning of crankpins, and "cheeking" of counterweights in simultaneous machining of two crankshafts.

Automated machines require three basic characteristics in their operating components—and particularly in their clutches and brakes.

First, they must provide instant response to electric or electronic controls, with full-power torque output for all work done by the machine.

Second, they must produce shock-free precision starts and stops for accurate cycling of the machine and the work.

Third, they must provide long maintenance-free operating life with automatic adjustment for operating wear.

For these and other inherent advantages, FAWICK Airflex Clutches and Brakes are used on Wickes MX-4 Crankpin Lathes. This outstanding full-automatic multi-stage machine is used to turn crankpins, and to "cheek" counterweights to the shoulder diameter of crankpins—with both operations carried out simultaneously on two crankshafts.

FAWICK Airflex products can improve your machine performance. For full information on the advantages they offer call or write your nearest FAWICK representative or the Home Office, Cleveland, Ohio.

Circle 687 on Page 17

FAWICK AIRFLEX DIVISION
FAWICK CORPORATION
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK
AIRFLEX

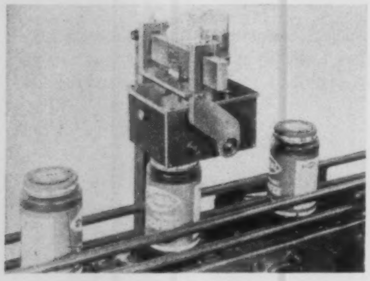
INDUSTRIAL CLUTCHES AND BRAKES

processed is complete. When the error has been determined and corrected, tape operation is resumed—there is no loss of synchronization or damage to the part. The block information is then transferred from temporary storage to an interpolator where it generates continuous trains of pulses for each of the four axes of motion. For any one of the four axes, pulses from the interpolator are fed into an error register that also receives feedback pulses indicative of actual member positions.

As these pulses enter the register and build up a count, a proportional error signal is amplified and delivered to a torque motor. The torque motor operates a control servo valve which controls the flow of oil to a hydraulic rotary motor and drives the machine slide.

The error register keeps a running count of the difference between the number of command pulses and the number of feedback pulses. When the feedback device returns to the error register the identical number of pulses originally specified for machine motion, the signal to the hydraulic valve drops to zero, stopping the servo motor, lead screw, and hence, that particular machine axis. While these functions are taking place, the photoelectric reader advances another block of data and holds it in temporary storage until the interpolator can accept it. **Industrial Controls Section, Bendix Aviation Corp.**, 21820 Wyoming Ave., Detroit 37, Mich.

Circle 407 on Page 17

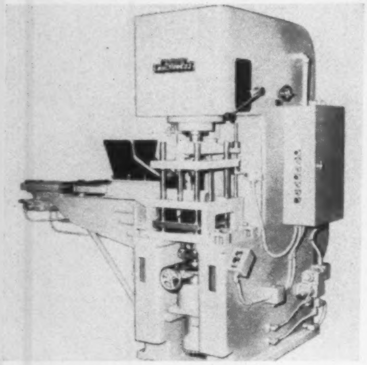


Jar Imprinter

Item 408

Small imprinting device can be attached to a conveyor to imprint data such as prices and codes on jar lids. The unit is mounted to overhang the conveyor, can imprint at a rate of up to 100 jars per minute. It is suitable on both flush and recessed lids. Recesses may be up to 3/32-inch deep. Adjustments set ink feed rate and impression pressure. A limit switch actuates the device. **Adolph Gottscho Inc.**, Hillside 5, N. J.

Circle 408 on Page 17



Compacting Press

Item 409

Line of hydraulic presses is suitable for compacting granulated or powdered materials such as metals, plastics, ceramics, abrasives, glass, carbon, or chemicals. The presses range in capacity from 5 tons through 75 tons for floor models and from 2 tons through 10 tons for bench models. A vibratory pressure principle is used, which causes the ram to make short, repeat strokes on the work during each ram cycle.

In operation, when a single lever control is moved to the continuous cycling position, a shuttle ram advances a hopper box across the die cavity, filling the die. When the die is filled, the shuttle box returns to the retracted position and the main press ram descends. As the ram descends, the punch enters the die and a limit switch causes the knockout ram to rise and compact the material with double-end pressure. When preset ram pressure is reached the main ram reverses and the knockout ram advances to its maximum extended position and ejects the compacted pieces from the die. On the next cycle the shuttle feed box advances automatically and pushes finished pieces from the tooling. **Denison Engineering Div., American Brake Shoe Co.**, 1160 Dublin Rd., Columbus 16, Ohio.

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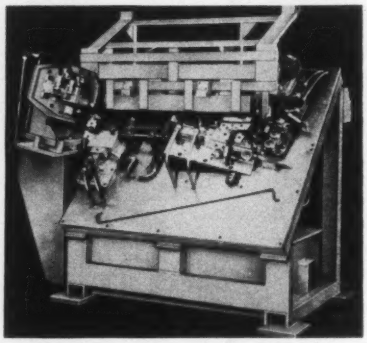


Wire Forming Unit

Item 410

Machine is capable of forming parts such as torsion rods for automotive hoods and trunks. The only manual function is when an operator feeds the rods, which are cut to length, into a hopper—the rest of the operations, including unloading, are automatic. In the event that the rods are not properly positioned, the machine will not operate. Unit is powered by a 2 hp hydraulic unit operating at 2000 psi. Production rate is 16 to 20 rods per minute. Machine is available in 3 models—for plain bending, or for right or left hand bending at irregular angles. **Worcester Automatic Machine Co.**, 91 Webster St., Worcester 3, Mass.

Circle 410 on Page 17

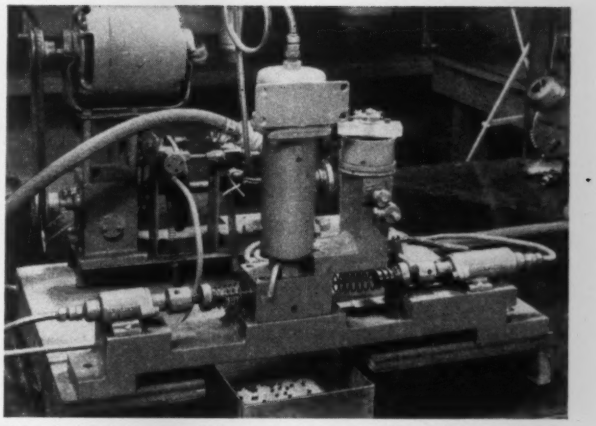
Ammonia Dissociator

Item 411

Ammonia dissociator generates protective atmospheres for bright brazing, bright annealing, bright hardening, bright tempering, and powder metallurgy processes in 100 cfh and 150 cfh capacity ranges. A U-shaped retort design, special

***Progress** in designing air systems:*

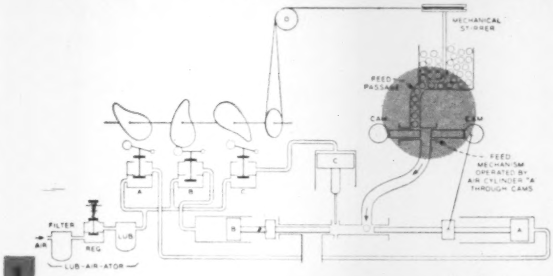
Here's another automating idea: Schrader Air Products in a multi-step punching system



Schrader Products successfully performing at prominent Western plant—feeding, shot-piercing, ejecting—all automatically with air.

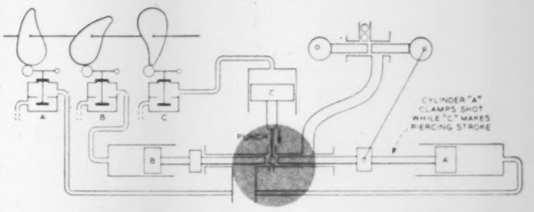
PROBLEM: To pierce tiny balls of lead shot, fast, accurately, and economically.

SOLUTION: Schrader Air Products designed into a system for automatic operation.


MECHANICAL STIRRER
FEED PASSAGE
CAM
CAM
FEED MECHANISM OPERATED BY AIR CYLINDER "A" THROUGH CAMS
A
B
C
C
B
A
FILTER
AIR
REG
LUB
LUB-AIR-ATOR

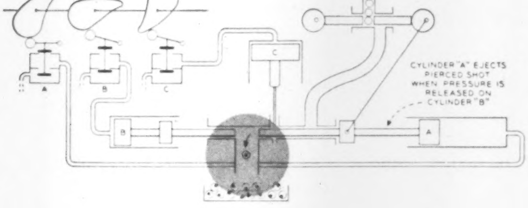
1

FEED: Performance of the cylinders in this system is controlled by cam-actuated Schrader valves. Cylinder A controls split-cam feed; allows the shot to be fed into the machine one at a time.


A
B
C
C
PUNCH
B
A
CYLINDER "A" CLAMPS SHOT WHILE "C" MAKES PIERCING STROKE

2

PIERCE: The shot is pushed forward and clamped at the piercing station by cylinder A and cylinder B. Cylinder C pierces the shot.


A
B
C
C
B
A
CYLINDER "A" EJECTS PIERCED SHOT WHEN PRESSURE IS RELEASED ON CYLINDER "B"

3

EJECT: Cylinder B returns to its initial position. Cylinder A completes its forward stroke, ejecting the pierced shot. And cycle starts again.

Air's benefits apply in almost any operation you can name: stamping, forming, programming, squeezing or measuring. And the advantages are more important today than ever: speed, accuracy, safety, simplicity, versatility, and—amazing economy. Schrader components are a natural for the designer because they comprise the only complete line of air products to select from. They can be used singly or in combination to perform jobs of amazing variety and complexity. When you design, think of air, and make use of Schrader's engineering facilities to help you specify the right products for your idea. Mail the coupon today.

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Name____________________ Title__________
Company____________________
Address____________________

Circle 688 on Page 17

catalysts, and vertical positioning of ceramic heating elements provide controlled processing. The dissociator can furnish protective atmospheres consisting of 75 per cent hydrogen and 25 per cent nitrogen, with a dew point of approximately −50 to −60 F. If a high grade of anhydrous ammonia is used, a dissociation of 99.95 per cent can be produced. **C. I. Hayes Inc.**, 808 Wellington Ave., Cranston 10, R. I.

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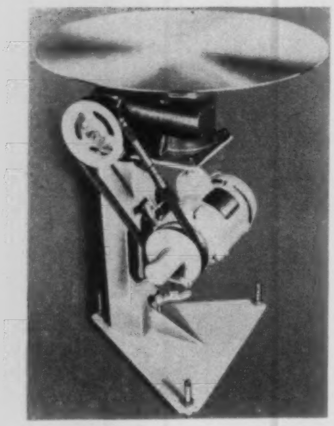

Rotary Table

Item 412

Variable speed rotary table can be used for transferring production units from one conveyor line to another; for accumulating production units in process; and for collecting finished production units at terminal points for labeling or cartoning. Table has a stainless steel top disc with a mild steel backup plate which maintains flatness. The disc is available in 18, 24, 30, 36, and 42-inch diameters, with the height adjustable from 33 to 36 inches. It is powered by a 1/2 or 3/4 hp totally enclosed motor; has a variable speed ratio of 2.7 to 1. **Standard Metal Products Co.**, 123 N. Racine Ave., Chicago 7, Ill.

Circle 412 on Page 17

Vibratory Feeder

Item 413

Device features an electro-permanent magnetic drive system that operates directly from ac without a rectifier. The spring system of Model V3B-70A is of epoxy-bonded fiberglass, is corrosion, fatigue, and abrasion resistant. The feeder, designed to distribute bulk materials, can also be used for spreading, drying, or agitating materials, handling hot materials, or moving materials into hot areas at precise rates. A variable auto-transformer type control is furnished to vary the applied line voltage, permitting adjustment to the optimum feed rate for any given material. The feeder is available as a base mounted unit (shown) or a suspended unit. **Eriez Mfg. Co.**, Erie 6, Pa.

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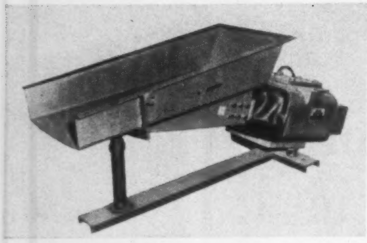

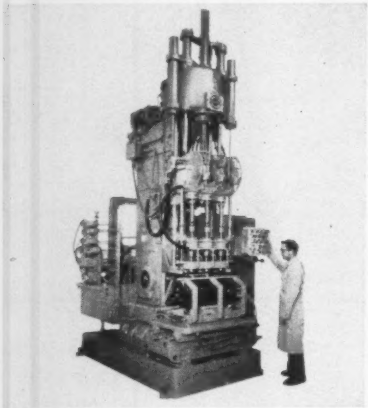

Multispindle Honer

Item 414

Machine has individually controlled pneumatic hone feeds for each of its three spindles. This design is said to allow hone feed pressure calibration for each spindle to compensate for varying operating conditions caused by bore size irregularities and different degrees of stock hardness. With this system, coarser stones can be used, while still maintaining a close finish tolerance.

When all three bores are sized, and the tools have collapsed but continue rotating, an automatic timer is actuated. The tools then expand simultaneously under constant low pressure to the walls of the bore. The timer gives a predetermined number of strokes (usually 3 to 5) to obtain the desired final surface finish. Approximately 0.003-inch stock is removed from the cylinder walls of 6-cylinder cast iron blocks being honed. Indexing action is automatic. Production rate is 32 blocks per hour at 80 per cent efficiency. Finish requirements maintained are 25 to 35 rms. **Barnes Drill Co.**, 836 Chestnut St., Rockford, Ill.

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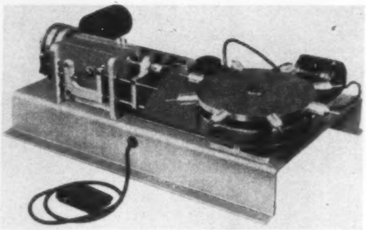


Coil Winder

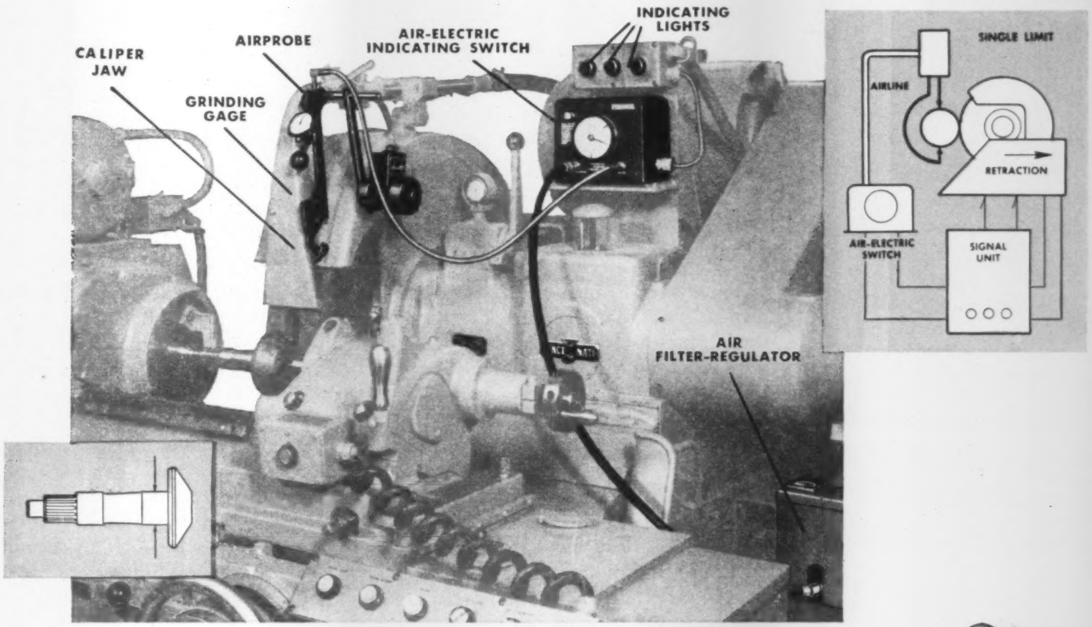
Item 415

Unit features an indexing dial so that an automatic coil form feeder and stripping, cementing, taping, and cutting stations can be added to the basic winder. When equipped with a hopper or magazine feed, complete bobbin or single layer coils can be produced automatically. Model CK has an eight-station indexing dial. Primary and secondary windings can be wound at different stations when two winding heads are supplied.

Wire spacing and turns per layer are determined by change gears. The length of the coil is adjustable through a wide range with the use of an adjustable cam mechanism. The number of layers and the number of turns in the coil are selected by a rotary switch which is coupled to a stepping switch acting as a counter. The turns per layer, total number of turns, and coil specifications must permit an even number of layers. Other models permit winding of coils with odd and fractional numbers of layers. Winding speeds as high as 6000 rpm can be accomplished. Maximum coil length is 1 1/2 inches; maximum coil diameter 2 inches. **Coil Winding Equipment Co.**, Oyster Bay, L. I., N. Y.

Circle 415 on Page 17

CONTROL FINISH SIZE
Automatically! Economically!



Automatic Control Gaging improves your grinding operation 3 ways . . .

1 It controls on the basis of finish size *only,* thus overcoming the disadvantages of timed cycle or fixed stop grinding. Wheel wear, O.D. variation in work to be ground, "give" in many of the machine elements, and flexing of the work, no longer affect accuracy and piece-to-piece uniformity of the finished part.

2 It controls *automatically,* thus you eliminate any errors caused by operator fatigue, inexperience, or inattention. The Federal automatic control gage never tires, will hold part size to .0001" or better on a good machine, and is easily adjusted to control different sizes of work. Its air-electric system overlooks minor surface irregularities which confuse size readings of other gages.

3 Automatic control gaging makes it possible for one operator to handle two grinders performing the same or different operations. Here's an actual case history of direct labor cost savings:

	MEN	MACHINES	COST PER PIECE	PRODUCTION RATE pieces per 8 hr. shift
BEFORE			$.03585	1344
CONTROL GAGING INSTALLED				
AFTER			$.01526	1386

SAVINGS (per piece)	**$.02059**
RATE INCREASE (per shift)	**42**
TOTAL SAVINGS (per shift)	**$28.59**

EQUIPMENT COST AMORTIZED — 60 DAYS

HOW IT WORKS

The Federal automatic control gage measures the work continuously *as metal is being removed* and automatically retracts the wheel the instant finish size is reached.

EASY TO INSTALL

This standardized Automatic Control Gage (Model 133M-103 illustrated) is stocked for speedy delivery. Only a few components to install. Easily applied to any plain grinder having hydraulic wheel slide. Can also be used in connection with wheel slide stop to *additionally* provide spark out.

Federal control gages are also available through machine tool manufacturers for control of either plain or I.D. grinders and are supplied as part of the grinder package. When discussing machine tool requirements, be sure to specify FEDERAL gaging. Federal maintains close engineering alliance with leading machine tool manufacturers. They, too, will be glad to discuss automatic control gaging with you.

For more information, contact the nearest FEDERAL representative or write . . .

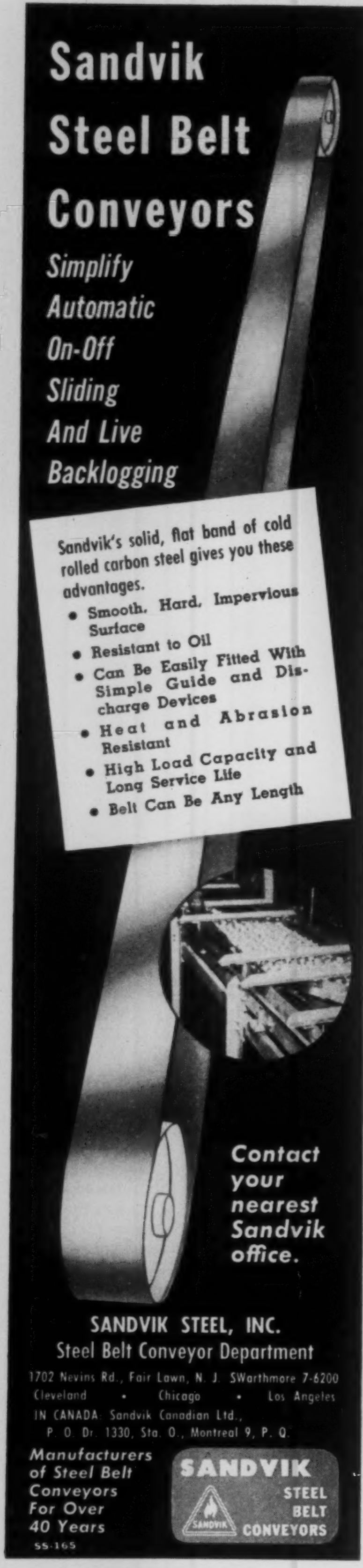
FEDERAL PRODUCTS CORPORATION
9396 Eddy Street, Providence 1, R. I.

Ask **FEDERAL** *First*

for recommendations in modern gages . . .

Dial Indicating, Air, Electric, or Electronic – for
Inspecting, Measuring, Sorting, or Automation Gaging

Circle 689 on Page 17



Sandvik
Steel Belt
Conveyors

Simplify
Automatic
On-Off
Sliding
And Live
Backlogging

Sandvik's solid, flat band of cold rolled carbon steel gives you these advantages.

- Smooth, Hard, Impervious Surface
- Resistant to Oil
- Can Be Easily Fitted With Simple Guide and Discharge Devices
- Heat and Abrasion Resistant
- High Load Capacity and Long Service Life
- Belt Can Be Any Length

Contact your nearest Sandvik office.

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Steel Belt Conveyor Department
1702 Nevins Rd., Fair Lawn, N. J. SWarthmore 7-6200
Cleveland • Chicago • Los Angeles
IN CANADA: Sandvik Canadian Ltd.,
P. O. Dr. 1330, Sta. O., Montreal 9, P. Q.

Manufacturers of Steel Belt Conveyors For Over 40 Years

SANDVIK STEEL BELT CONVEYORS

SS-165

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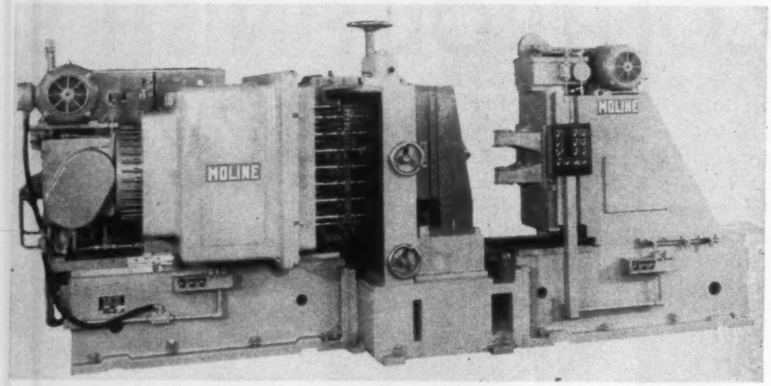

Multispindle Drilling/Milling Machine

Item 416

Tractor transmission cases are drilled and milled on a machine that combines two horizontal drilling units and a milling unit attached to a central base. The work-holding fixture is carried on the base. When a pushbutton control is operated, the automatic operating cycle begins. The hydraulic feed cycle consists of: Rapid advance, feed, and withdrawal to starting position. Individual control of the horizontal travel of the drilling and milling units is included for setup and tool adjustment.

The drilling unit at the left in the photo has 47 universal joint-driven, slip-type spindles, each located in a plate. Nine additional spindle drivers are provided for future use. Drilling area is 30 by 54 inches. The universal joint drive permits relocation of spindles to any point within the drilling area by use of a different plate. Main drive of the unit has a two-speed and neutral, quick-shift selector which controls the rotational speed of all spindles simultaneously. A pickoff gear case is included for establishing desired spindle speeds.

The rear drilling unit has 12 universal joint-driven spindles (drilling area is 32 by 18 inches). A second plate carries 11 similar spindles which drill an intermediate wall in the workpiece. The two-spindle, vertical milling unit, right, has a pair of milling cutters for machining bosses located in recesses of the transmission case. The vertical distance between the two pairs of milling cutters can be changed to suit different boss locations. **Moline Tool Co.,** 102 20th St., Moline, Ill.

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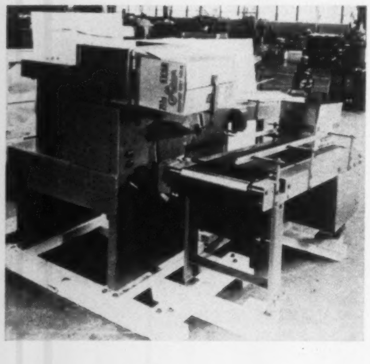


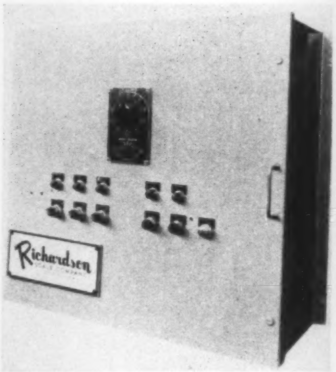
Case Packer

Item 417

Unit is capable of loading packages or cartons into cases at speeds up to 16 cases per minute in single or double tier loads. Model 806 includes an infeed conveyor, a funnel, and a case take-away conveyor. The packing operation is completed without turning, twisting, or upending the package. The pusher will not operate unless a case is in position to receive the packages. Cases cannot be discharged unless they have a full load.

In operation, packages are received from production conveyors in single lines. The package is oriented to travel with its largest area on the belt. The infeed conveyor delivers the packages to a load-forming area in the packer funnel. When the load conforms to the desired load pattern, a pneumatically operated lift table pushes one row of packages up through gates in the funnel. The gates close, holding the row of packages, and the lift table returns. The cycle is repeated the proper number of times to obtain a full load. When the proper load is accumulated, a pneumatically operated pusher loads the packages into the waiting case. At the end of the pusher cycle, the case is lowered to the case take-away conveyor. The operator then places an empty case over the funnel and the machine starts a new packing cycle. **Portland Div., Emhart Mfg. Co.,** Portland, Conn.

Circle 417 on Page 17

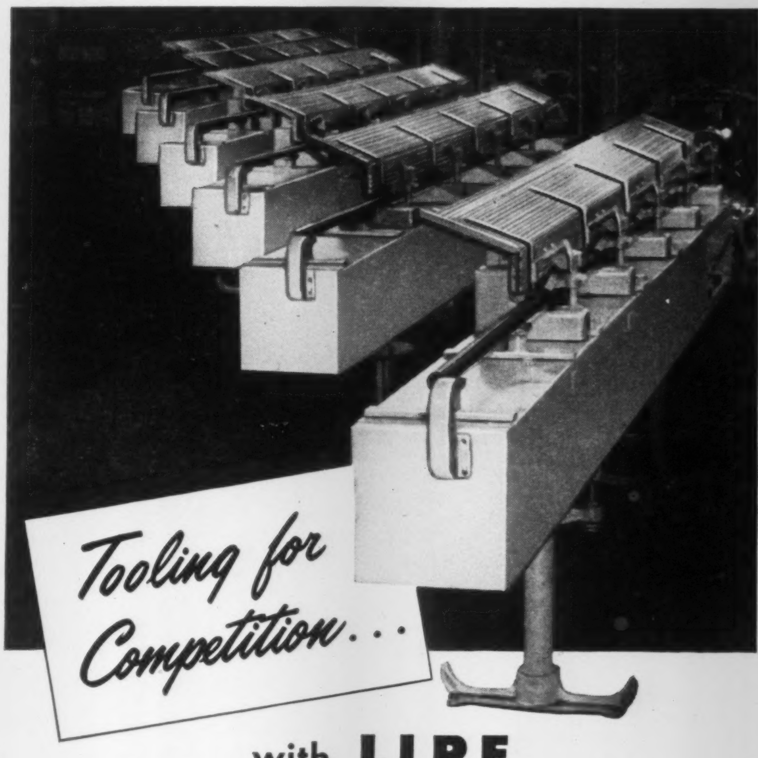


Weight Control System

Item 418

Automatic tare-out system can direct the process of filling a variety of containers with the same amount of material each time, regardless of the weight of each container. A wall-mounted panel contains controls to position a container on the weigh platform, dial in the desired weight, tare-out the weight of the container, deliver the material, and remove the filled container.

In operation, by means of dialing, an operator selects the weight to be added to the container. The system starts when he presses a button which sends an impulse to a material feeder conveyor. Compensation is automatically made for the weight of the container. When the dialed weight has been added to the container, another impulse is given to the conveyor system to remove the filled container from the weigh platform and replace it with an empty container. Production rate is two cycles per minute. The cycle



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Automatic Machine Loading

● You can meet and beat competition by getting peak production from every machine in your shop — new *and* old. Lipe Automatic Machine Loading delivers at least 90% of the gross geared capacity of any production machine, because stock is fed continuously. Your machines cut stock — not air!

● Lipe AML Bar Feeds automatically feed stock of practically every length, shape and material, in close-tolerance feedouts. Users report production increases of 40% . . . 90% . . . and even 200% per machine, plus labor benefits that are even more important. Workers are freed from back-breaking hand-loading of stock . . . concentrate on quality and machine set-ups. For a free estimate of what Lipe AML can do for your shop, send prints or samples of typical work. Write for full information.

Stop Cutting Air and You Start Cutting Costs

Lipe-ROLLWAY
CORPORATION
SYRACUSE 1, N. Y.

PIONEERS IN PNEUMATIC BAR-FEEDING

Circle 691 on Page 17

MULTI-MINIATURE
FEATURES
with
PACKLESS
"DEMI G"
VALVES

Photo
¾ actual
size

"DEMI G" SERIES

Packless "DEMI G" Valves are miniature in size, weight and price. They employ a patented form and give bubble-tight shut-off. They are available in many bar-stock materials with a wide variety of tee-handle and toggle actuators and have innumerable applications in the chemical, oil, instrumentation, aircraft and atomic energy fields . . . to name but a few.

Basic "DEMI G" Valves employ metal-to-metal seating, however TEFLON seats for vacuum service, neoprene diaphragms for toggle actuation and all TEFLON interior models . . . as well as those with bolted bonnets are standardly available. Where space and exacting control are considerations, the "DEMI G" Series of packless valves will do the job better.

PRESSURE RATING Metal Body & Diaphragm Neoprene Diaphragm TEFLON Body & Diaphragm	 750 psi at 450°F 100 psi at 180°F 100 psi at 450°F
MAXIMUM Cv	0.4
CONNECTIONS	1/16" to ½" N.P.T.

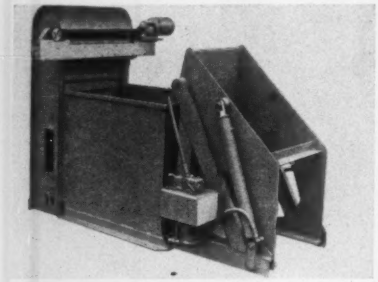
Send for the "DEMI" Catalog D-1 and other technical data on Dahl pneumatic and hydraulic valves.

GEORGE W.
DAHL
COMPANY, INC.
86 TUPELO STREET, BRISTOL, RHODE ISLAND

Circle 692 on Page 17

automatically repeats itself until either the operator stops the system or the material runs out. **Richardson Scale Co.,** Clifton, N. J.

Circle 418 on Page 17



Hopper Feeder

Item 419

Device combines a vane-type elevator with a powered out-feed mechanism, is suitable for aligning and conveying cylindrical parts or stock length bars or tubes of steel, copper, brass, aluminum, fiber, and nylon. Up to 7000 average length cylindrical pieces per hour can be fed into centerless grinders, automatic lathes, dial feed presses, forming machines, and billet heaters. The out-feed mechanism is capable of conveying parts up to 20 feet from the feeder escapement to the operating machine. A feature of the unit is an adjustable feed speed with a safety slip clutch which eliminates the possibility of overfeeding the parts. Model shown has a supplementary hopper loader at right. **Clark Industries,** P.O. Box 314, Delaware, Ohio.

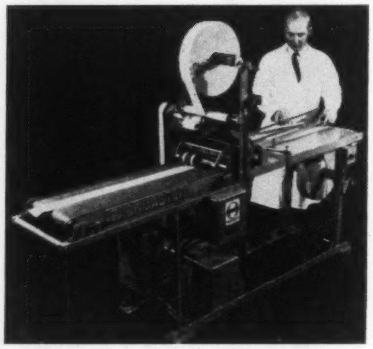
Circle 419 on Page 17

Double Disc Grinder

Item 420

Double horizontal spindle disc grinder is available with 36 or 42-inch diameter abrasive discs, with a variety of work carrying fixtures for grinding metallic or nonmetallic workpieces up to 18 inches in diameter. Model 2H40L (shown with a 42-inch disc) has a rotary carrier fixture for grinding two parallel sides of valve plates 5.395-inches in diameter by 0.170 inch thick. It is equipped with a horizontal trough loader for feeding parts into the stations of the rotary carrier; an automatic face cut mechanism for progressive stock removal; a diamond dresser which is automatically actuated after a preselected number of parts have been ground; an automatic size control; and an integral wet grinding system. **Gardner Machine Co.,** Dept. 31, Beloit, Wis.

Circle 420 on Page 17

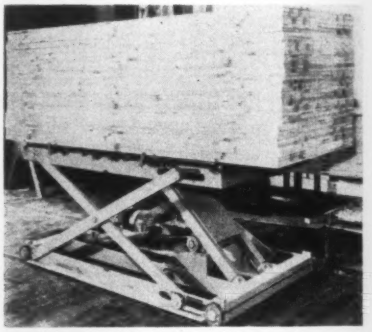


Long Parts Packager

Item 421

Long, irregular objects in a variety of shapes can be packaged by portable machine, designated Packmaster Model 56. It can handle objects from ¼ to 2 inches thick, packaging them in cohesive paper up to 12 inches wide. In operation, parts are placed between sponge rubber rollers and automatically fed through the wrapping, cutoff, and marking stations. The finish-wrapped part is then ejected into a shipping container or onto an exit belt. The rubber rollers squeeze the cohesive paper strips together around the part being packaged to form a tight, dustproof, conforming wrapping. No adjustments need be made when the length of part changes—cutoff occurs as the end of each part passes a rider bar. Production rates up to 120 fpm can be obtained. An optional attachment is a printing device which can imprint the package with as many as 9 lines, repeating the impression every 7 inches. **Sundstrand-American Broach, Div., Sundstrand Machine Tool Co.,** Ann Arbor, Mich.

Circle 421 on Page 17



Hydraulic Lift Table

Item 422

Suitable for numerous materials handling operations, hydraulic lift table is 40 inches wide, 76 inches long, has a raised height of 43 inches and a collapsed height of 9 inches. A feature of the table is that the material load is lifted at the center of the unit. No stress is placed on the leveling cross arms by balanced loads. The table is rated to lift 5000 lb, and has a generous overload factor. Unit is available in portable or wheel-mounted styles, with roller, flat, or concave table tops. Self-contained 1 hp motor and hydraulic system lift loaded table at the rate of 2 ips. Lowering speed is 5 ips. **United Products Co., Div., Meridan Corp.,** 3001 N. Star St., Tacoma, Wash.

Circle 422 on Page 17

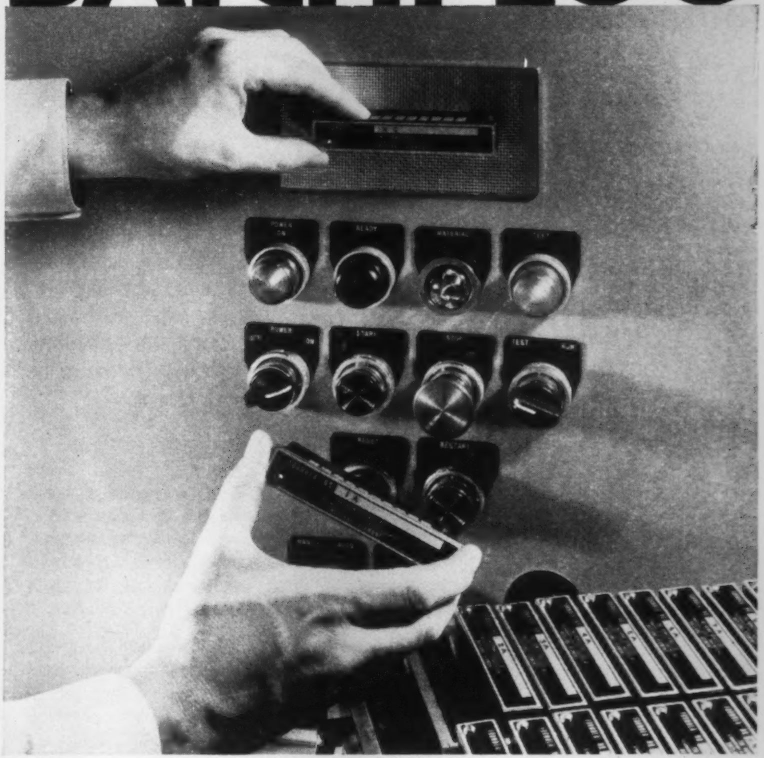
Woodworking Cutoff Saw

Item 423

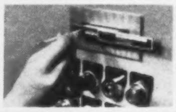
Automatic cutoff saw can operate at 50 strokes per minute, with a

NEW LOW COST AUTOMATIC BATCHING
WITH **INSTANT** FORMULA CHANGING

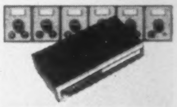
HOWE BATCHPLUG



❶ Quickly and easily adjusted to accurate settings.



❷ Each standard Batchplug controls up to 10 ingredients, 3 scales.



❸ Sealed for privacy—no dials to reset—no operator error.

❹ Inserting Batchplug changes entire plant to new formula instantly.

The Howe BATCHPLUG* cuts panel and circuit costs—puts automatic batching in everybody's reach! Simple, rugged, easily set for any formula up to 10 ingredients. An exclusive Howe development!

**Pat. Pending*

HOWE

THE HOWE SCALE CO. • RUTLAND, VT.
A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

WRITE TODAY
FOR OFFICE
DEMONSTRATION
OR NEW BATCHPLUG
FOLDER

Circle 693 on Page 17

Need Automation?

To CUT COSTS
INCREASE PRODUCTION
IMPROVE QUALITY CONTROL
REDUCE HANDLING

YOUR ANSWER IS:

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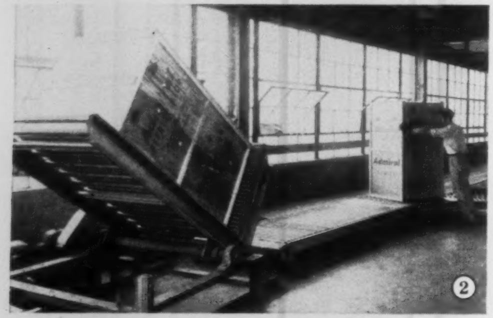
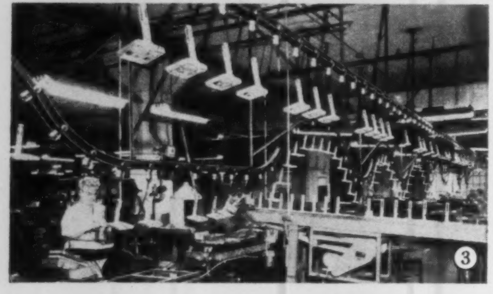
Whatever your handling problem Buschman makes low-cost production a reality. Buschman experience-engineered conveyors give you low initial and operating costs with proved dependability. Here are some typical examples.



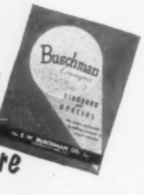
1 Nearly ten million pieces each month are handled and shipped by a leading bearing producer's computer-controlled warehouse equipped with Buschman Wheel & Roller Conveyors.

2 Up-enders, down-enders and special units for increased handling efficiency are easily integrated into standardized conveyor systems for major appliance makers.

3 Overhead trolley cable conveyors carry light to medium weight loads thru all operations at convenient heights in this modern manufacturing plant.



Write Today for literature



What is your problem? Remember, Buschman offers the most complete range of conveyors to save time and cut costs.

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THE E. W. BUSCHMAN CO.
4551 Clifton Avenue, Cincinnati 32, Ohio

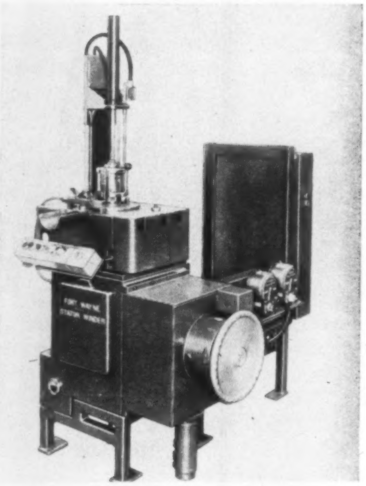
C-354-EWB

CONVEYORS FOR EVERY INDUSTRY

Circle 694 on Page 17

stroke length setting of 10 inches. A stroke control rod can be rotated to provide three lengths of stroke, a maximum of up to 20 inches. A combination of compressed air and a hydraulic check is used to feed and retract the aluminum head carriage. The carriage moves on sealed ball-bearings mounted in the base. The lower bearings are adjusted by means of eccentric mounting studs. The saw head of Model 435 is mounted on steel posts and has a 1-inch vertical adjustment to compensate for blade wear. It is powered by a $7\frac{1}{2}$ hp, 3600 rpm motor. Either a right or left hand saw blade mounting can be furnished. Several types of discharge feeding arrangements are available. **Greenlee Bros. & Co.**, 2136 Twelfth St., Rockford, Ill.

Circle 423 on Page 17



Stator Winder

Item 424

Machine can automatically and simultaneously wind 2 and 3-group concentric coils, at a winding speed of 325 turns per minute. Preparation time is 15 seconds and there are only four forms to place and remove. One operator can tend two or more machines. On a 4-pole stator with four 3-group concentric coils being wound simultaneously at 125 turns per coil, the machine can produce 88 stators per hour. **Fort Wayne Tool, Die & Engineering Co.**, 1025 Goshen Ave., Fort Wayne, Ind.

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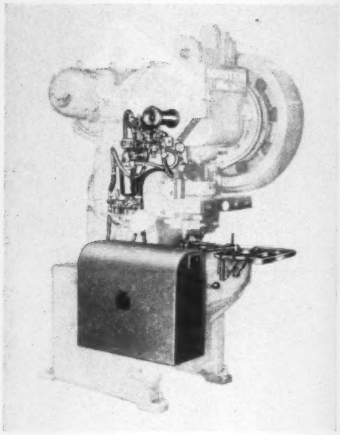

Press Loader/Unloader

Item 425

Device is available for attachment to OBI presses operating at 30 to 60 strokes per minute and also for flywheel presses running up to 165 strokes per minute. The unit is a mechanically and pneumatically operated mechanism (with vacuum cups) which picks up parts in succession from an adjacent table, locates each part precisely in the die nest, actuates the press, and ejects the finished part. Production rate is from 1800 to 3600 pieces per hour. The unit can be adapted for use with hopper feeds, magazine feeds, stacker feeds, and rotary tables. **Press Engineering Co. Inc.**, 5722 E. Chicago Ave., Chicago 51, Ill.

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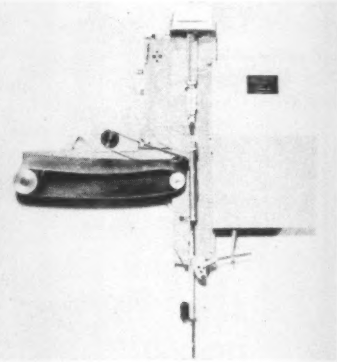

Electrolytic Marker

Item 426

Saw blades, electronic parts, gages, bearings, and drills can be automatically marked using an electrolytic marking process by plating, etching, or oxidizing method. Any type of lettering or line drawing can be marked on any conductive material. In one type of operation, carbide workpieces are magazine fed upward by an air-operated device. When the part is in marking position, the electrode head lowers, marks, and retracts. The marked piece is pushed onto a rubber conveyor belt and a new part is indexed into position. When the magazine is empty, the machine stops automatically. **Electromark Corp.**, 2093 E. 19th St., Cleveland 15, Ohio.

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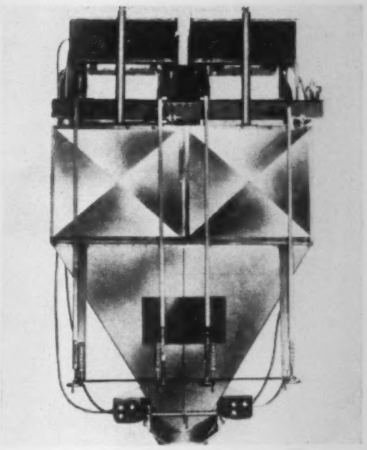

Bagging Scale

Item 427

Automatic filling unit includes two net weigher sections which discharge into a common hopper. Model 2N18CC consists of two sets of bulk and dribble feeders, two weigh hoppers, two totally enclosed plate scales, a dust cabinet, and a separate control panel. A bag holder is optional equipment. In operation, a supply feeder feeds material to the weigh hoppers. As one is being filled and weighed, the other is discharging into the package. Materials can be dumped automatically into empty packages on a synchronized conveyor. Unit can be set to make from 25 to 30 dumps per minute for package capacities of from 25 to 100 lb each. **Thayer Scale Corp.**, Thayer Park, Pembroke, Mass.

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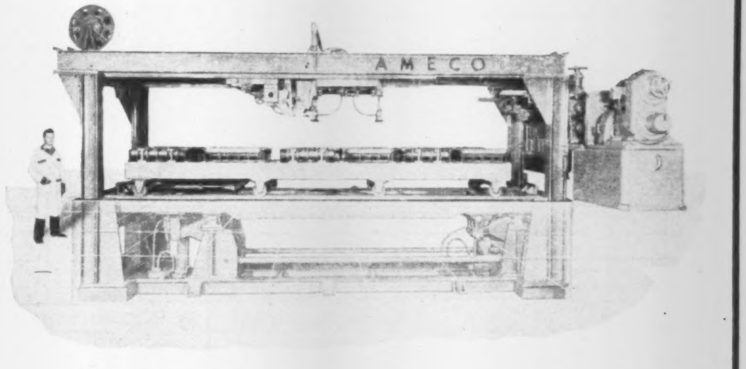
AUTOMATIC SHEET STEEL FEEDER



SPECIFICATIONS:

1—Sheet Length . . . 5′ to 20′
2—Sheet Width . . . . . 1′ to 5′
3—Sheet Gauge . . . #16 to ⅜″
4—Stack Height . . . . 0″ to 18″
5—Stack Weight . . 20,000# Max.
6—Feeding Speed 60 to 180′/Min.

FEATURES:

1—No Delay between transfer of sheets.
2—Deformed Edges rolled flat.
3—Table inches up automatically.
4—Power Rolls feed stacks from standby table

AUTOMATION MACHINES & EQUIPMENT CO., INC.
3130 WEST MILL ROAD
MILWAUKEE 9, WISCONSIN

Circle 695 on Page 17

NEW
NEW
TWO WAY
THREE WAY

(Actual Size)

NEW SOLENOID VALVES *by* Airmatic

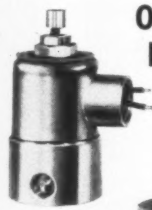
These corrosion-proof valves have only one internal moving part and a completely protected solenoid coil. The coil is fully sealed from air, oil, gas and water . . . and will not overheat on continuous duty. Coils for continuous or intermittent duty, a-c or d-c, are interchangeable.

Life expectancy is many millions of cycles and by renewing the one-piece valve plunger, many millions more can be expected. The plunger can be replaced without disturbing rigid piping.

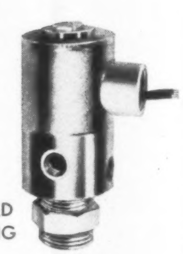
DISTRIBUTORSHIPS FOR THESE NEW VALVES ARE AVAILABLE

SPECIFICATIONS		
	TWO-WAY	**THREE-WAY**
CATALOG NO.	91011	91011
PRESSURE RANGE	1/16″ ORIFICE: 0-500 PSI 3/16″ ORIFICE: 0- 70 PSI	1/8″ ORIFICE: 0-300 PSI 3/16″ ORIFICE: 0-100 PSI
ORIFICES	1/16″ THROUGH 3/16″	1/8″ AND 3/16″
VOLTAGE	MOST A-C AND D-C	MOST A-C AND D-C
DUTY	CONTINUOUS	CONTINUOUS
POWER CONSUMPTION	10 - 20 WATTS	10 - 20 WATTS
HEAT RISE	WITHIN UL LIMITS	WITHIN UL LIMITS

OPTIONAL DESIGNS

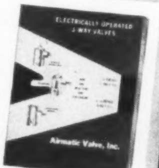


MANUAL OVER-RIDE



MANIFOLD MOUNTING

ASK FOR CATALOG



All valve deliveries are made from stock.

AIRMATIC VALVE, Inc.

7313 Associate Avenue • Cleveland 9, Ohio

EVERYTHING UNDER CONTROL

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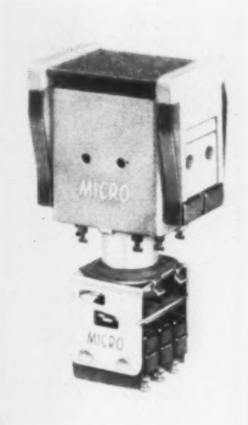
Circle 696 on Page 17

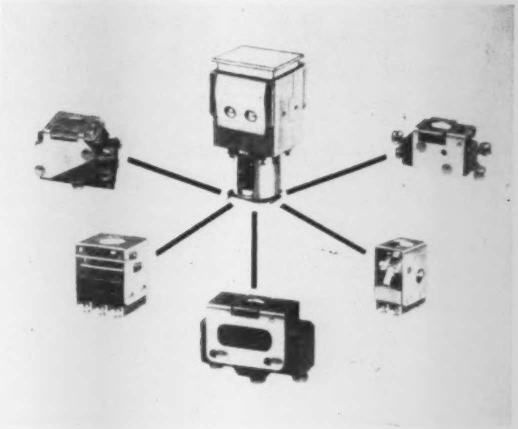
AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems.

For detailed information and literature, use card page 17.

Lighted Pushbuttons Control and Indicate





DESIGN of modular lighted indicator and pushbutton switch devices provides versatility for operations which require combined control and indicating functions. These units were developed by **Micro Switch, Div., Minneapolis-Honeywell Regulator Co.,** Freeport, Ill. Each modular indicator-switch assembly consists of a translucent pushbutton (display screen), operator-indicator unit, lamps, and a switch unit. By selecting the proper modular components, almost any switching function can be performed.

Two mounting styles are available—barrier-mount and flange-mount. With the barrier-mount style, mounting barriers can be attached to the sides or ends of the lamp housings. Any number of units can be combined with barriers between the units and on each end of a group. The entire assemblies of units and barriers can be snapped into slots in the mounting panel. In the flange-mount style, the mounting springs are already attached to the light boxes; all that is needed is to snap the desired number of units into a mounting slot. In both styles, after the operator-indicators are installed in the panels, their lamp terminals are wired and the switch units are attached by clipping them to the operator-indicator units. Indicator colors and styles available include single and two-color display screens in red, white, yellow, blue, and green. Another indication system is the projected-color method. With projected color, only white screens are used and small red, yellow, blue, or green filters are installed over the lamps. When the indicator lamps are turned on, the colors of the filters are projected evenly on the display screens. By alternately illuminating different colored filters, the projected-color screens change color.

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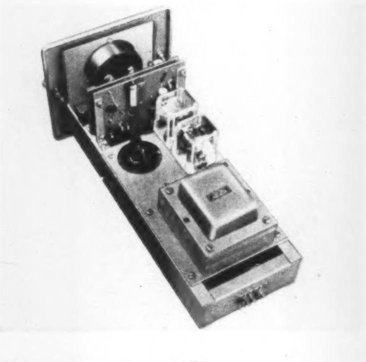
Multipoint Temperature Monitoring System



Alarm-indicator module shows the master control which adjusts the alarm temperature for all points simultaneously.

Unit is capable of monitoring many points continuously, can detect and warn when the temperature at any protected point reaches a preselected high or low limit. This system can measure temperatures between −25 and +600 F in generators, turbines, pumps, and other rotating equipment. It can also be used for a temperature protection of processes, processing equipment, and pipelines.

Device has no sampling or scanning devices; the sensing points are terminated in a multiple-channel bridge network which receives and

Continuous monitoring system consists of a monitor module (left) and an alarm-indicator module (right). All points are monitored continuously and simultaneously and no scanning devices are used.

monitors all inputs simultaneously and continuously. This feature is said to increase the reliability of the system and provide an instantaneous response to an abnormal condition at any point, regardless of the total number of points in the system.

Continuous monitoring system is designed around two types of modular units—a monitor module which handles the inputs from a group of 10 sensing points; and an alarm-indicator module which can handle the inputs from 10 individual monitoring modules, representing a capacity of 100 sensing points per amplifier. Each alarm-indicator module contains an amplifier, temperature indicator, alarm circuit, and connections for any secondary switching or control functions required during an alarm condition. The system can be supplied to detect temperatures above a preset limit, below a preset limit, and out-of-band between upper and lower limits. The alarm temperature for each sensing point can be set individually; it can also be raised or lowered for all points simultaneously by a master adjustment in the alarm-indicator module. **Fenwal Inc.**, Ashland, Mass.

Circle 429 on Page 17

Automatic Panning Mount

Item 430

Camera mount is designed to circle from side to side in a continuous back-and-forth action, panning the TV camera over an adjustable sector. Built-in speed controls allow the scanning cycle to be varied over a wide range. Model ARC-11B is constructed to support heavy acoustical or weatherproof housings like those used near outdoor test stands or in conjunction with industrial surveillance systems. A single control panel (which can be up to 3000 feet away from the camera) provides command over the scanning action. Enclosed electric motors and worm gears pan the camera from side to side, and tilt it up and down. Panning speed can be varied from zero to 12 degrees per second; tilting speed from zero to 4 degrees per second. Unit can operate in ambient temperatures varying from zero to 160 F and altitudes from sea level up to 12,000 ft. **Kin Tel, Div., Cohu Electronics Inc.**, 5725 Kearny Villa Rd., San Diego 12, Calif.

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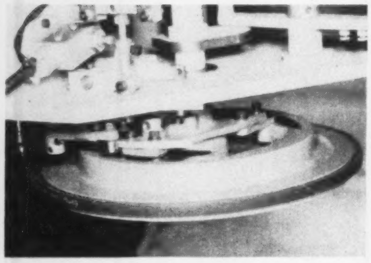

One Revolution Clutch

Item 431

Unit features an adjustable torque control which provides automatic, positive rotation on a shaft from a continuously rotating source of power. Clutch has a ball bearing equipped flywheel that is adaptable to V-belt, gear, or direct drive. It can be mounted either at the end or in the middle of a shaft. The single revolution, brakeshoe type clutch has a positive positioning device at disengagement, can be used for clockwise or counterclockwise rotation. Model K is rated at 1/3 hp at 100 rpm, and designed for speeds up to 150 rpm. Standard shaft size is ¾ inch. **Theodore M. Wright Inc.**, Dept. B, P. O. Box 286, Camden 1, N. J.

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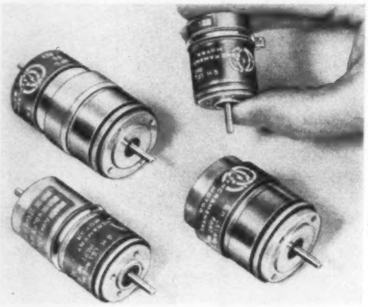

Stepping Motors

Item 432

Suitable for translating pulses into incremental shaft positions, stepping motors can be used to rotate control mechanisms, potentiometers, counters, and rotary switches on computers, recorders, or other electronic devices. A 36-degree angular increment per pulse gives 10 indexing positions with ±½ degree detent accuracy at a maximum stepping rate of 15 per second. Shaft indexing is performed by a clutch, mounted with detent mechanism between two rotary solenoids with facing armature plates on bidirectional models, on the end of a single solenoid on unidirectional models. The solenoid de-energizing returns the armature to the original position, while the clutch and shaft are held in a displaced position by the detent. The clutch drive reduces shaft overcoast and provides a braking action at the end of each step for higher inertia loads. A wide range of operating voltages is available and mounting style is either servo or stud. **G. H. Leland Inc.**, 123 Webster St., Dayton 2, Ohio.

Circle 432 on Page 17

Professional Personnel Requisition

Controls & Instrumentation Engineers

Marquardt Aircraft — a leader in air and space propulsion and control systems, high altitude rocket research and weapon support systems — offers a creative engineering environment in which you will find significant active projects. These include engine control systems for nuclear turbojet, inlet control systems for the North American F-108 and Hound Dog missile, control systems for the supersonic ramjet engine, feasibility studies of advanced and unique engine cycles, nozzle control for advanced ballistic missile components and other power system actuators. These control units include fluid and gas operated servo systems suited for environments above one thousand degrees.

If you are an engineer experienced in fluid dynamics or fluid operated controls and interested in mechanisms designed for severe environmental conditions, you should consider one of the following engineering opportunities at Marquardt:

CONTROLS DESIGN

To create components for pneumatic and hydraulic control systems. Work ranges from simple piston actuators to complex speed computing devices. All designed for high sensitivity, fast response, extreme environmental conditions and light weight. Should be experienced in machine design and have an understanding of basic design analysis.

CONTROLS ANALYSIS

To investigate aircraft and missile control problems through the application of analysis methods in mechanics and dynamics, heat transfer, compressible flow, and servomechanisms. Position offers opportunity for creative engineering.

CONTROLS DEVELOPMENT

Opportunity to create workable controls components. Must have a "feel" for hardware and desire to undertake broad engineering responsibility. Opportunity to solve "on-the-spot" engineering problems utilizing pneumatic and hydraulic control analysis techniques.

ENGINEERING STANDARDS

Implement, establish and/or originate the use of standards both design and hardware for reduction of time and cost of engineering effort. Must have knowledge of hydraulic and pneumatic design and components. Should be capable of setting up an evaluation program as required. Requires ability to work with many engineering groups both in advisory and service capacity.

CONTROL RELIABILITY

To predict reliability of control of units and recommend appropriate design changes. Knowledge of servomechanisms and feedback theory desirable. Should have background in statistics and experience in reliability field.

INSTRUMENTATION

Specification and design of instrument components and systems for ground testing of supersonic ramjet engines, jet engine components, inlet controls, nuclear powerplant controls and emergency power units. Prefer instrumentation experience, including data acquisition and processing equipment. Familiar with process control systems.

For additional information, please write

Mr. Floyd E. Hargiss, Manager
Professional Personnel, Dept. L-2.
Marquardt Aircraft Co.
16555 Saticoy Street
Van Nuys, California

Marquardt
AIRCRAFT CO.

VAN NUYS AND POMONA, CALIFORNIA — OGDEN, UTAH

COOPER DEVELOPMENT CORP. — MONROVIA, CALIFORNIA — A MARQUARDT SUBSIDIARY

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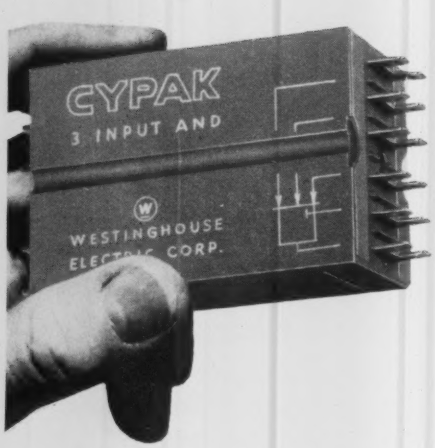
PLEASE TAKE TICKET

Westinghouse CYPAK control . . . tickets and tabs 400,000 cars per year at automatic parking lot



The Port of New York Authority uses Westinghouse Cypak® static control to automatically control the flow of 400,000 cars per year at the New York International Airport parking lot.

From the moment a car pulls up at the entrance, Cypak goes to work . . . it automatically and unerringly controls the issuing of the parking ticket . . . raises the gate so that the car may pass . . . and keeps a running record of the number of cars passing in and out.

When accuracy is a must and shutdowns cannot be tolerated, chances are Westinghouse Cypak is the answer to your control problem. It has no moving parts to weaken or wear . . . it never needs to be replaced . . . and it's not affected by moisture, dust, acids or other contaminants. Cypak saves time, gives perfect accuracy and reduces maintenance. Cypak's versatility lends itself to easy circuit changes and modifications.

Westinghouse Cypak control may be just the "ticket" for the problem you're working on right now. A call to your nearby Westinghouse sales office brings you all the facts. Or, write to Westinghouse Electric Corporation, Director Systems Department, 356 Collins Avenue, Pittsburgh 6, Pennsylvania. J-01012

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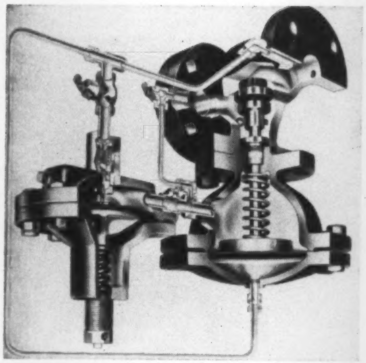
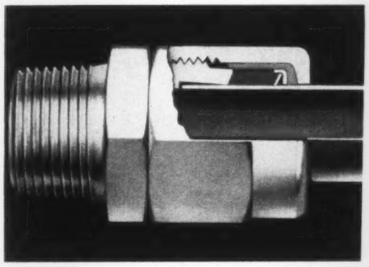


Pressure Reducing Valve

Item 433

Pilot operated pressure reducing valve can control steam, air, natural and other gases, water, oil, or almost any fluid medium. It is capable of pressure reductions from 600 psig initial to as low as 1 psig reduced, in one step. This is made possible by using the upstream pressure (which is magnified by a diaphragm) to modulate the valve disc against the flow, this force being so great that it nullifies the force created across the seat and disc due to pressure reduction. A diaphragm pilot controls the pressure on the main valve diaphragm. Reduced pressures are adjustable between zero and 125 psig by unscrewing an adjusting nut and changing springs in the pilot. The pilot seat and ball valve can be removed and replaced on the body section of the pilot without removing the pilot from the line. **C. E. Squires Co.,** 18502 Syracuse Ave., Cleveland 10, Ohio.

Circle 433 on Page 17

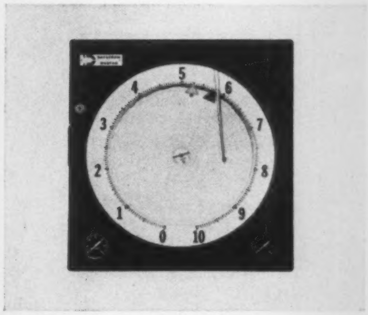


Flareless Tube Fitting

Item 434

Suitable for either hydraulic or pneumatic systems, fitting provides a positive seal at high, medium, or low pressures, and permits tube movement even where tubes are misaligned due to manufacturing variables. A built-in positive stop prevents over-or-under torquing the fitting. Feature of the fitting is the cushion unit (comprised of the cushion, anchor, retainer, and seal) which is completely assembled. **Chicago Forging & Mfg. Co.,** 2000 N. Southport Ave., Chicago 14, Ill.

Circle 434 on Page 17



Circular Chart Recorder

Item 435

Instrument is available with either electric or pneumatic controls. With pneumatic controls, it is furnished as a universal controller, proportional plus automatic reset, or proportional with automatic reset and derivative. Proportional band adjustability is −2 to 300 per cent. With electric controls, the unit is furnished as contact type (two-position or three-position) and proportioning control with 5, 10, or 20 per cent proportional band. Features of the controller are: Interchangeable slidewires, replaceable range standards, plug-in amplifiers, universal mountings, and recessed indicator pointers. Recorder is designed for ac operation only at 115 v, 60 cycles; or 115 v, 50 cycles as specified; accuracy is ±0.25 per cent of span, or 0.025 mv. **Daystrom-Weston Industrial Div., Daystrom Inc.,** 614 Frelinghuysen Ave., Newark 12, N. J.

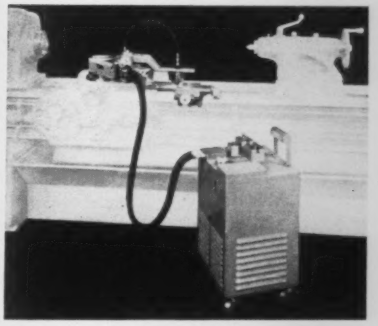
Circle 435 on Page 17

Impulse Switch

Item 436

Suitable for pneumatic or hydraulic cylinder applications, one-way impulse switch provides electrical control for solenoid valves and starter relays. A sealed die-cast housing makes it adaptable for machine tool applications. All moving parts are constructed of hardened stainless steel to resist corrosion and wear. Life of the unit is said to be over 5,000,000 actuations. Switch is rated for 15a, 125/250/460 vac, 15a res 5a ind, 5a motor, 30 vdc. **Licon Switch Div., Illinois Tool Works,** 2501 N. Keeler Ave., Chicago 39, Ill.

Circle 436 on Page 17



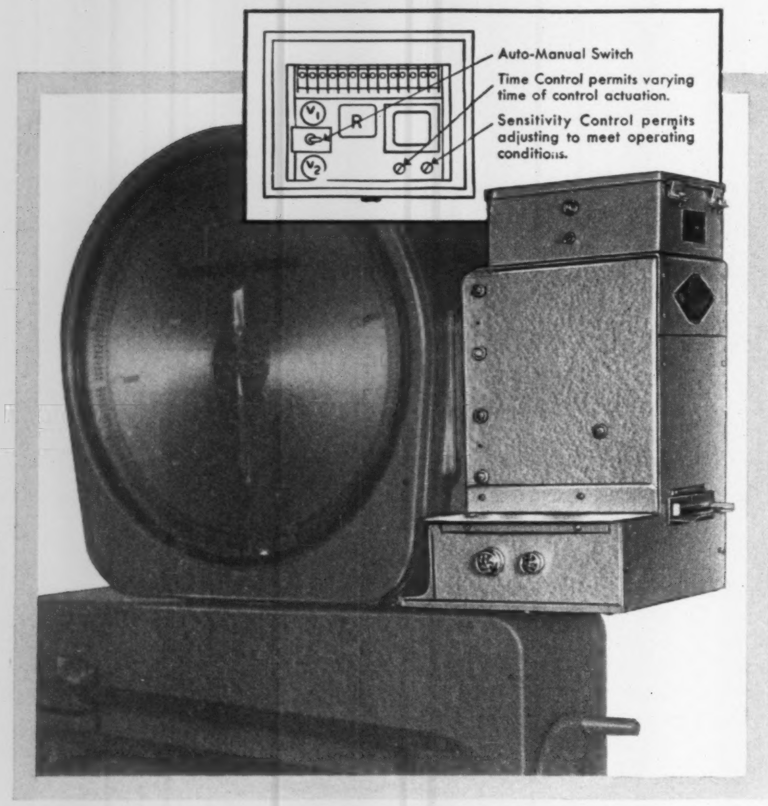
Lathe Tracer

Item 437

Pneumatic tracing attachment includes a hydraulically powered tool slide and a swivel base, designed for use on company's Series 60, 61, and 62 machines. The base is furnished with the proper height and bolt circle size according to the lathe with which it is to be used. The template support is clamped to the front bed "V". Micrometer dials are provided for longitudinal and cross adjustment of the template position. A swivel pin on the support is used in conjunction with a micrometer adjusting bracket for template alignment. Hydraulic pump motor operates on 110 v, single phase ac. **Monarch Machine Tool Co.,** Sidney, Ohio.

Circle 437 on Page 17

NEW Fairbanks-Morse Electronic Weight Detector


Auto-Manual Switch
Time Control permits varying time of control actuation.
Sensitivity Control permits adjusting to meet operating conditions.
V1
R
V2

Prevents incorrect weighing . . . stops costly errors!

With the new Electronic Weight Detector, true weight of any load can be automatically obtained and recorded without need of a weighman. Where a weighman is used, it is impossible for him to record incorrect weights or start a sequence at the wrong time. When desired, a flip of the switch can disengage the Weight Detector entirely from the system. *This is the first fully-reliable control of its kind available in the scale industry.*

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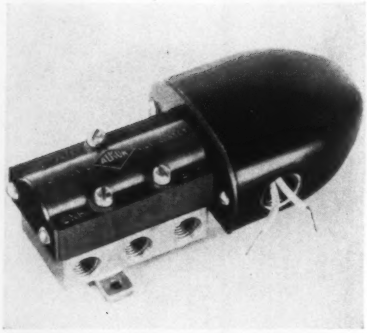
Circle 699 on Page 17

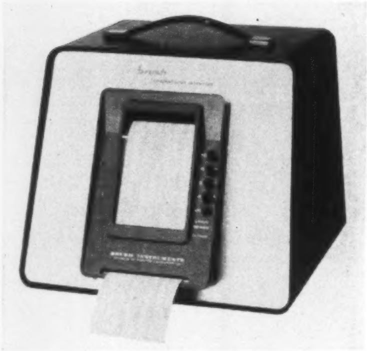


Four-Way Air Valve

Item 438

Sub-base mounted, four-way valve is rated at 200 psi or vacuum air service. Precision tolerances of 0.000050-inch provides the valve assemblies with consistent sealing characteristics. All ports of the valve have unrestricted full pipe area passages, for high flow capacity. Types of actuation available include: Hand, foot, pilot, cam, solenoid, or bleeder. **Alkon Products Corp.**, 200 Central Ave., Hawthorne, N. J.

Circle 438 on Page 17

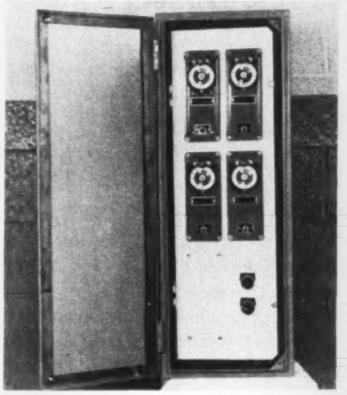


Portable Monitor

Item 439

Monitor is suitable for recording the operation of relays, valves, motors, pumps, and other equipment; for production testing and monitoring operation of computers, automatic equipment and controls; for monitoring the operation of pulse systems; and for recording productive and idle time of machines. The instrument can record 30 channels of on-off, open-shut, pulse, or event type information, providing a chart record of all operations and their duration. Model RE 3303-00 has a transistorized electric wiring system that is unaffected by ambient conditions. A wide range of chart speeds provides signal resolutions as small as 0.004 seconds. **Brush Instruments, Div., Clevite Corp.**, 37th & Perkins, Cleveland 14, Ohio.

Circle 439 on Page 17



Press Control Panel

Item 440

Designed for old style presses, control panel can automate the press cycle. When attached to the press, the panel will actuate the timing of unloading equipment, die lifters, sheet loaders, dopers, etc. The control takes up a minimum of floor space, can be adapted to almost any style press. **Sahlin Engineering Co. Inc.**, P. O. Box 289, Birmingham, Mich.

Circle 440 on Page 17

Photoelectric Head

Item 441

Miniature photoelectric heads can operate up to 10,000 counts per minute, depending on the relay unit that is used. Both the lamp and photocell units are 1¼ by ¾ by 2½ inches. Three models of re-

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Achieve efficient, automatic production, and produce more all along the line, by integrating equipment designed and built by AUTOMATION for automation.

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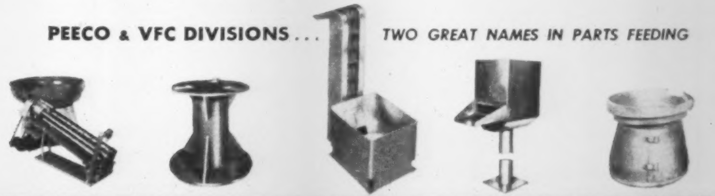

AUTOMATION DEVICES INC.
ERIE, PENNSYLVANIA

Circle 700 on Page 17

lays of varying capacities are available. The photoelectric heads are made of solid aluminum, machined to house components. **Worner Electronic Devices**, Box 2, Rankin, Ill.

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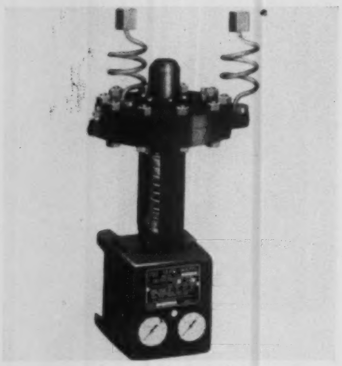

Liquid Level Control

Item 442

Liquid level control pilot features an adjustable proportional band. By means of a single knob adjustment, the proportional band can be set while the liquid level system is in operation, without affecting the liquid level set point. Unit uses the differential pressure sensing method, is unaffected by surface turbulence. Only two small connections to the vessel are required. **Leslie Co.**, 144B Delafield Ave., Lyndhurst, N. J.

Circle 442 on Page 17

Liquid/Gas Filter

Item 443

Compressed air, gases, hydraulic fluids, liquid fuels, liquid chemicals, lubricating oils, and water are a few of the applications for which this stainless steel filter can be used. The filter, which is designed for operating pressure up to 750 psig, uses a 10-inch filter tube (either cotton, nylon, orlon, dynel, acetate, or glass fibers). A wide range of precision densities is available to provide any degree of continuous micro-clarity, down to 1 mu. Maximum air flow rate is 650 scfm at 750 psig operating pressure with initial pressure loss of 3 psi. Flow rates for liquids varies according to the nature of fluid and operating conditions, with maximum of 5 gpm for liquid with viscosity of water. **Commercial Filters Corp.**, 2 Main St., Melrose, Mass.

Circle 443 on Page 17

A-C MEGAWAT
MEGAWA
GENERAL ELECTRIC

Double Recorder

Item 444

Instrument is capable of plotting two related electrical quantities (such as watts and vars, volts and frequency, or wind direction and speed) side-by-side on a single chart. Model CH-37 has two separate recording mechanisms which trace on two 4-inch calibrated charts printed on a record roll 10 inches wide. Features of the recorder are: Throw-away inkwell, gasket-sealed door with key-operated lock, multiple chart speeds, a chart supply indicator, and a fluorescent-lighted chart face for easy reading. Unit is available with either a single speed synchronous motor giving 11 chart speeds ranging from 1/4 to 30 inches per hour or a double speed synchronous motor giving 28 speeds from 1/4 inch per hour to 120 inches per minute. **General Electric Co.**, Schenectady 5, N. Y.

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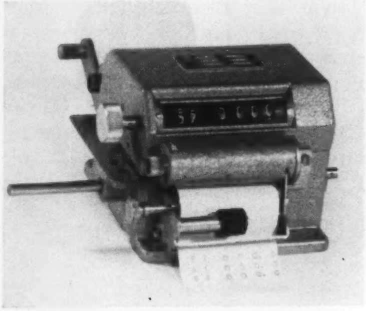

Printing Counter

Item 445

Shaft input printing counter can be driven by servo or synchro motors. The counting rate of Model U 2715 is 5000 counts per minute maximum, either adding or subtracting. Maximum number of digits is 7, or 6 with reset. Resetting and printing are accomplished electrically. The printing is aligned to the nearest whole number and is effected with print wheels continuously coupled to the input shaft. Parallel visual wheels mesh to printing wheels, giving progress indication at all times. Printing can be on tape or card. **Presin Co.** 2014 Broadway, Santa Monica, Calif.

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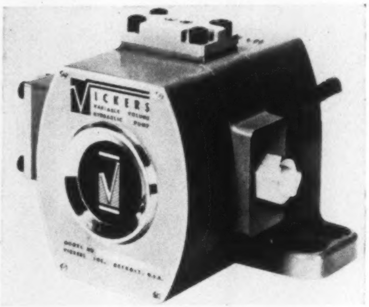

Hydraulic Vane Pump

Item 446

Variable delivery 5 gpm vane type pump features an integral pressure compensator which controls pump volume at preselected adjustable pressures. The pump is designed to automatically limit its delivery to system demand. Pressure compensation can be varied from 200 to 1000 psi. Sharp cut-off characteristics enable the pump to deliver nearly full volume up to the compensator setting even at low operating pressures. Nominal 5 gpm rating is at 1800 rpm. Maximum pressure rating is 1000 psi. Pump can be flanged, foot, or gasket mounted. **Vickers Inc., Div., Sperry Rand Corp.,** 1450 Oakman Blvd., Detroit 32, Mich.

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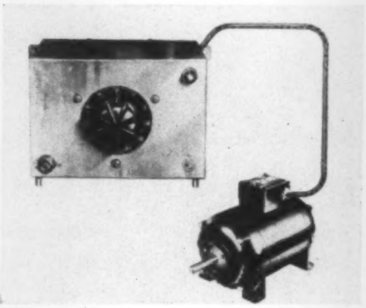

Adjustable-Speed Drive

Item 447

Line of adjustable-speed drives is furnished in 17 different models ranging from 1/20 to 3/4 hp. Unit is said to have smooth control from zero to maximum rated speed. Conservative rating of rectifiers and motors provides continuous operation at any speed. The entire controlled rectifier is contained in a compact enclosure which is designed for either bench use or wall mounting. **Servo-Tek Products Co.,** 1086 Goffle Rd., Hawthorne, N. J.

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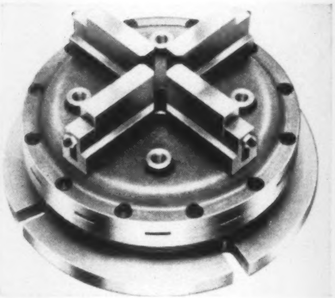

Air Operated Chuck

Item 448

Air operated diaphragm chuck is available in three styles. Model 5 1/2 has a diameter capacity of 1/8 to 3 inches, with a piston area of 13.80 sq in.; Model 7 has a diameter capacity of 1/2 to 4 1/4 inches, with a piston area of 24.74 sq in.; and Model 10 has a diameter capacity of 1 to 6 1/2 inches, with a piston

Circle 701 on Page 17→

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area of 49.68 sq in. Work pieces can be chucked either internally or externally. Chuck also features a quick-change diaphragm replacement, interchangeable jaws, and sludge slots. **Erickson Tool Co.**, 34350 Solon Rd., Solon, Ohio.

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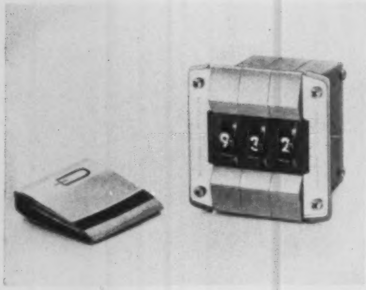

In-Line Switches

Item 449

Modular in-line switch is finger controlled and provides for ten-position, single pole, binary coded decimal 1, 2, 4, 8 or octal 0, 1, 2, 4 coded outputs. Any number of switch modules can be stacked together to meet specific requirements (illustration shows three units stacked together). Contacts are rated for 200 v, 1 amp and contact resistance is 0.5 ohms. **Digitran Co.**, 45 W. Union St., Pasadena, Calif.

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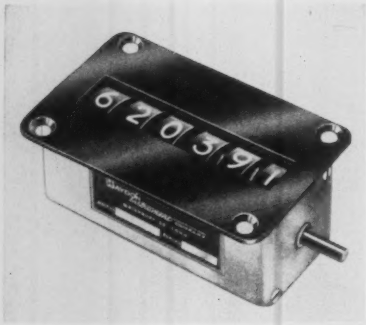

Mechanical Counter

Item 450

Six-digit device uses a planetary gear drive to rotate the numerals. The transfer of numbers is accomplished by means of a nylon cam and roller compensating device which moves the planetary gear. This method keeps the gears in mesh. The smooth action of the planetary gears makes it possible to drive the counting wheels at continuous speeds of 1000 rpm. Life of the unit is said to be in excess of 100,000,000 counts. Only a low torque is required to turn the drums and there are no peak load points in the operation of the counter; any device capable of turning the first numeral drum is capable of driving the entire counter. **Haydon Instrument Co.**, 165 W. Liberty St., Waterbury 20, Conn.

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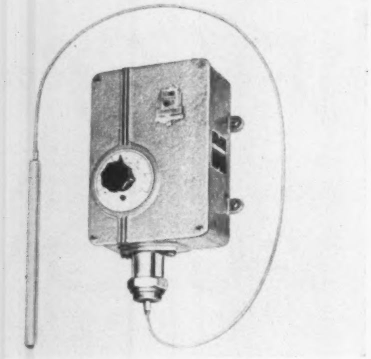

Temperature Control

Item 451

Designed for multistage cooling or heating, temperature control is applicable in the transportation of perishable products or frozen foods where a close control of temperature is required. The control is equipped with from two to five switches, each of which can be independently set to operate at any point on the scale. It is possible to set up any combination of up to four functions to operate in sequence on rise or fall of temperature. Model ZC is constructed with a minimum of moving parts and operates through the simple and positive action of the expansion of mercury. Model ZCC is similar except for the addition of a separate auxiliary switch operated by the temperature set knob. This switch can be preset to open if the knob is turned below a predetermined point. It permits cutting out one of the control switches either above or below a predetermined setting of the control knob. **Partlow Corp.**, New Hartford, N. Y.

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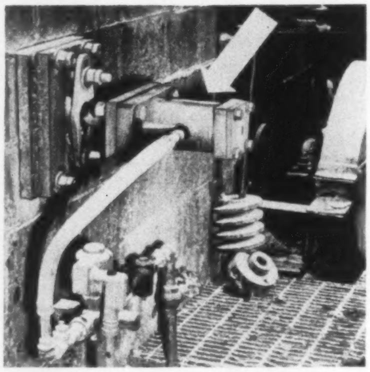

Air Vibrator

Item 452

When equipped with a timer and solenoid valve, impact air vibrator furnishes automatic cleaning action on electrostatic precipitators and dust collectors. With the use of this unit, maintenance problems, which interrupt the continuous operation of the precipitators and the collectors, are reduced. Heavy-duty unit uses no tierods, and the piston is the only moving part. Weight of Model BH-3-SP is 52 lb. **National Air Vibrator Co.**, 2372 W. Seventh St., Cleveland 13, Ohio.

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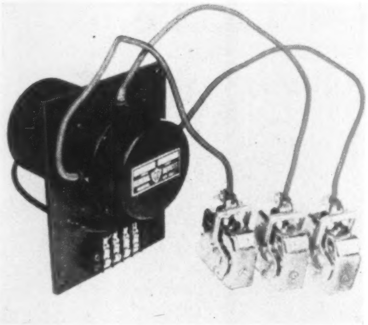

Sampling Commutator

Item 453

Switch is designed to allow the sampling of low signal levels. The cover can be removed for inspection purposes while the switch is operating. The rotor and the brush assembly can be replaced without brush force or phase adjustments. Switch is said to have a total life of thousands of hours. It will operate on a 60 cycle, 115 v, single phase hysteresis motor and integral gear train drive, and 3 mechanically synchronized poles composed of 30 shorting or 15 nonshorting channels per pole at 1 rps. Model 105A has multipin connectors at the end of the cables. **General Devices Inc.**, P.O. Box 253, Princeton, N. J.

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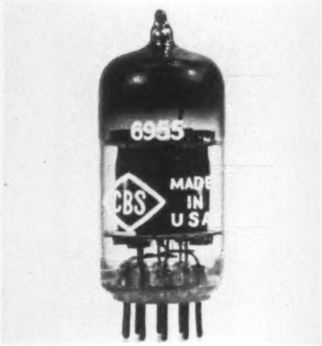

Pulse Amplifier

Item 454

Designed specifically for blocking oscillator service where high emission capability is needed in a short time for high peak power, pulse amplifier can also be used for square-wave modulators, multivibrators, and on all kinds of timer circuits. The 9-pin amplifier can supply two amperes of peak current in 10 microsecond pulses. Model 6955 is said to provide reliable operation even under unfavorable environment, due to an ambient range of −62 to 100 C, with special resonant vibration testing at frequencies up to 500 cps. **CBS-Hytron, Div., Columbia Broadcasting System Inc.**, Parker Street, Newburyport, Mass.

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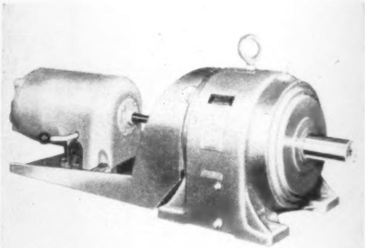

Multiple Speed Drive

Item 455

Combination gear reducer and gearshift drive unit provides 4 or 8 output shaft speeds. Motor ca-

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WORM GEAR
JACKS

Many designers find a ready answer to precise control of linear motion in machinery or equipment with built-in Duff-Norton Worm Gear Jacks.

They are used singly, in tandem and in multiple jacking arrangements to position loads weighing from a few hundred pounds to as much as several hundred tons.

When connected in tandem or groups of four, six or more, these jacks always raise or lower in exact unison regardless of load distribution. They are also used for application of pressure, to push or pull and as linear actuators.

Duff-Norton Worm Gear Jacks are self-locking and will hold heavy loads in position indefinitely without any creep. Since there is no fluid or air to leak, the action is always positive and maintenance is no problem.

These jacks are available in eight standard models with capacities ranging from 2 to 100 tons and with standard raises from 6 to 24 inches. Special raises can also be furnished.

To learn more about how Duff-Norton Worm Gear Jacks may be used in your equipment, send for the bulletin which shows engineering drawings of jacks, Duff-Norton Mitre Gear Boxes and typical applications. Ask for AD-66a.

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COFFING HOIST DIVISION • Danville, Illinois

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Circle 702 on Page 17

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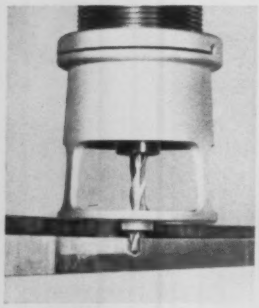
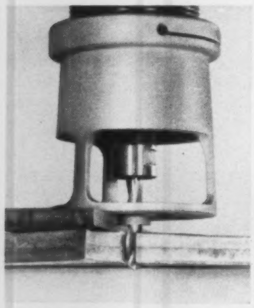
compact, lightweight— length, 7¼" . . weight, 3 lbs.
dependable air motor by Buckeye, producers of the world's first successful rotary air tools.
positive locking, vibration-proof depth adjustment.
corrosion resistant protective plating.
oversize bearing for side thrust cutting force.
full shank, full-grip collet.
open, "clear-view" construction.
template guide.

for precision cutting of the most intricate contours in metals, plastics, wood and honeycomb materials

self-cleaning . . . air exhaust directed downward to expedite chip removal.



PARTIAL CUT . . .



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INDUSTRIAL AIR TOOLS SINCE 1920

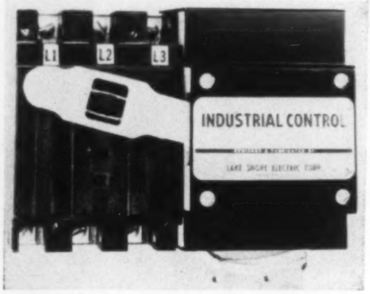
Buckeye Tools CORPORATION

5009 SPRINGBORO PIKE, DAYTON, OHIO

Circle 703 on Page 17

pacities are rated from 1 to 10 hp. By moving the shift lever on the gearshift drive into one of four positions, four different output shaft rpm's are obtained on the gear reducer. By using a two speed motor in the gearshift drive, eight different speeds are obtained on the gear reducer output shaft. Electrical characteristics of the unit are: Constant-torque, 3 or 2 phase, 60 cycle, 208, 220/440 or 550 v. **Lima Electric Motor Co. Inc.**, Dept. 286, Lima, Ohio.

Circle 455 on Page 17



L1
L2
L3
INDUSTRIAL CONTROL
LAKE SHORE ELECTRIC CORP.

Circuit Breaker

Item 456

Solenoid-operated circuit breaker is suitable for use with a variety of automatic controls for multiple-circuit, mixed-load service. Types of applications include: Remote-operated breaker, limited-duty motor starter, automatic lighting controls, remote control main service switch, and automatic industrial battery charger cutoff. Capacities of the units are 0-50 and 50-100 amp at 240 v, 480 v, and 600 v ac and 125 and 250 v dc, with interrupting capacities rated at up to 10,000 amp rms.

The solenoids which open and close the breaker are used with all voltages, ac or dc. The switch is thrown from open to closed position by momentarily energizing the proper solenoid. An interlocking latch and pivoting trip bar throws the breaker switch to the desired position. In the event of over-current or outage, an overload on any pole opens all poles, minimizing the possibility of single-phasing polyphase motors. Remote-indicating lights can also be provided to show switch position. **Lake Shore Electric Corp.**, 205 Willis St., Bedford, Ohio.

Circle 456 on Page 17

Circle 704 on Page 120→

GAYLORD SERVES YOU FROM SEEDLING TO STYLING

From forest to paper mill to design and printing, Gaylord constantly searches out new ways to improve your packaging operations.

All this experience and creative technology support the G-Man who works with you. Whether you need corrugated boxes by the millions or engineered packaging, it costs no more to call your Gaylord man. He's resourceful.

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PLANTS COAST TO COAST

DIVISION OF **Crown Zellerbach Corporation**

Another RCA AUTOMATION Product for Better Materials Handling

Low cost automatic

RCA ROTARY HOPPER

Compare the cost and features of these new RCA Automatic Rotary Hoppers, and you'll see why they are gaining such rapid acceptance! They provide every needed operating feature, yet are offered at remarkably low prices . . . beginning at $265, f.o.b., Detroit.

Features:

- **High-speed—up to 20,000 parts per hour.**
- **Handles cylindrical, rectangular, headed disc shaped and other parts.**
- **Parts orientation performed by feed track, not the bowl.**
- **Feed tracks easily changed by loosening one screw.**
- **18", 24", 30" bowls available.**
- **Rugged construction—cast-iron frame; driving mechanism supported by heavy duty self-aligning bearings.**
- **Standard gear-head motor.**
- **Safety-slip drive protects parts and equipment.**
- **Price includes cleats on selector ring and mounting block for tracks.**
- **Demand-control mechanism and wide variety of discharge tracks furnished at modest extra cost.**

Write today for complete information on low-cost RCA Rotary Hoppers. To permit analysis of your needs, send two samples of each part to be handled, and indicate required production rates. Details of other RCA Automation Equipment available on request.

RCA Tmk(s)®

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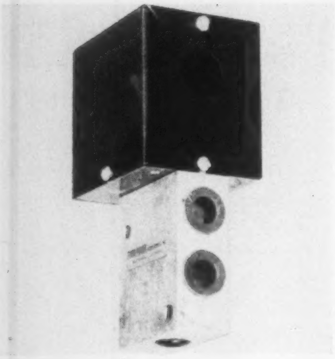
INDUSTRIAL AND AUTOMATION DIVISION
12611 Arnold Ave., Detroit 39, Mich.
Circle 705 on Page 17

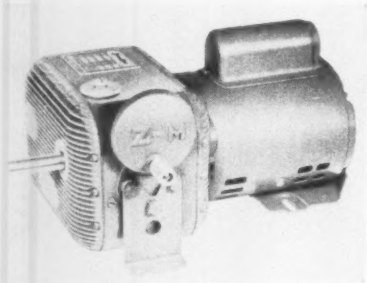


Solenoid Oil Valve

Item 457

Designed for pressures to 3000 psi, 2-way and 3-way valves are available in $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{3}{4}$-inch pipe sizes for ac or dc solenoid control. Solenoids feature a short plunger stroke (0.030 to 0.040-inch) and are interchangeable. The unit can be mounted in any position, and all internal moving parts are hardened and ground steel for tight shut-off and long life. **Fluid Power Accessories Inc.**, 2051 Railroad Ave., Glenview, Ill.

Circle 457 on Page 17

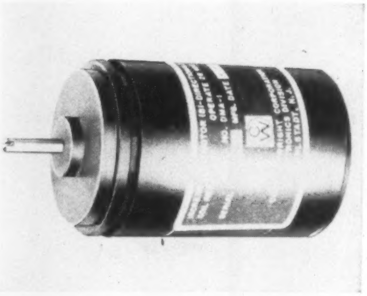


Speed Reducer

Item 458

Unit is applicable on positioners, conveyors, and machine tools in metalworking, mixing, blending, and measuring operations. It will provide infinitely variable speed from zero to 400 rpm with a constant torque of 60 or 100 lb-in delivered from $\frac{1}{2}$ or $\frac{3}{4}$ hp motors. The unit is available with or without motors. The motor is an open frame, dripproof, 60 cycle, 115/230 v, 1 phase, capacitator start unit. Reducer can operate in any position and will accurately repeat speeds and instantly change speeds whether the unit is running or stopped. It will also serve as a clutch going to zero rpm. Output shafts drive in either direction and are free-wheeling in direction of drive. **Revco Inc.**, 1900 S. Lyndale Ave., Minneapolis 5, Minn.

Circle 458 on Page 17



Incremental Motor

Item 459

Bidirectional stepping motor can be programmed by a tape to actuate different types of automatic equipment, providing a dead-beat precision control. It can also be used as an actuator for automatic pilots, converting digital quantities into equivalent physical positions. Model DM operates on the electromagnetic principle, converting electrical pulses to stepping motion on the output shaft. Unit resists shock and vibration; indexes and locks positively so that external forces cannot effect the position of the shaft. It is rated for 28 v dc; available for 30 and 36-degree indexes. **Components Dept., Electronics Div., Curtiss-Wright Corp.**, 620 Passaic Ave., West Caldwell, N. J.

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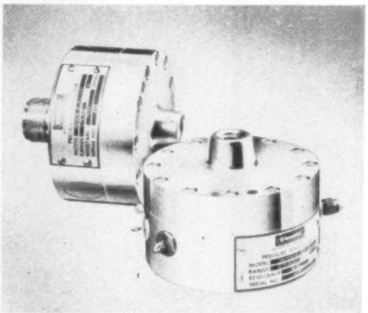
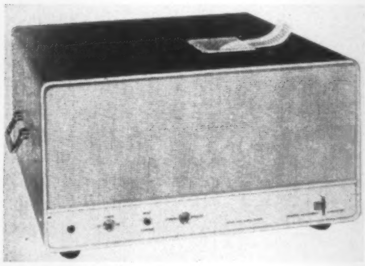


Pressure Transducers

Item 460

Units are designed for noncorrosive gas or liquid pressure measurement within the ranges of 0-100 psi to 0-6000 psi differential or gage, and 0-100 psi to 0-1000 psi absolute. The oil-filled transducers can withstand vibration of 25 g up to 20,000 cps. By using special alloy Bourdon tubes, error is minimized over a temperature range of −55 to 149 C. The Bourdon tube is center-mounted and coupled with the potentiometer coil and brush to provide less hysteresis and more resolution for a given vibration level. Other applications of the transducers are to actuate telemetering or recording devices directly without amplification. **G. M. Giannini & Co. Inc.**, 918 E. Green St., Pasadena 1, Calif.

Circle 460 on Page 17

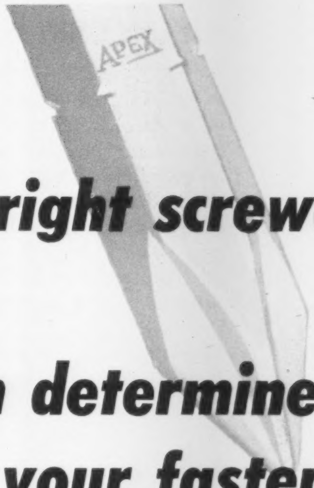


Digital Printer

Item 461

Suitable for telemetering systems, digital data systems, and batching operations, instrument can automatically print digital data from electronic counters, scalers, frequency meters, and data handling equipment. For special applications, the unit can be adapted to accept a 1-2-4-8 binary code. Model 400C is a 6-digit printer, can be equipped to give a ten line output from each digit for operating card and tape punches and electric typewriters. The output can be used with either serial or parallel entry devices. A built-in inhibit circuit prevents the basic counting instrument from starting a new counting cycle until the printer has completed the cycle. Optional features of the instrument are: An analog output for driving strip chart and other pen-type graphic recorders; a print-line identification for coding any desired line of printed numbers; and a transistorized drive which accepts low voltage inputs. **Computer Measurements Corp.**, 5528 Vineland Ave., North Hollywood, Calif.

Circle 461 on Page 17



the right screwdriving bit can determine your fastening costs

The *right* screwdriving bit is designed for a specific screw size, then hardened and tempered for a specific type of screwdriving application.

With the *right* bit you'll assemble more products in less time, have fewer rejects, and drive more screws per bit.

The *right* screwdriving bit for your application will be found in Catalog 30-C, along with the complete line of Apex screwdriving tools . . . for use with all established makes of drivers . . . to drive Phillips, Frearson (Reed & Prince), Slotted, Clutch Head, Socket Head, Hex Head and even special types of screws. Write, on your company letterhead, for your copy.

APEX INSERT BITS (Used with Apex Bit Holders) for Phillips cross-recessed-head screws and bolts

POINT SIZES: #0 through #4

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SD-1055
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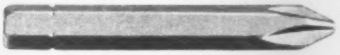


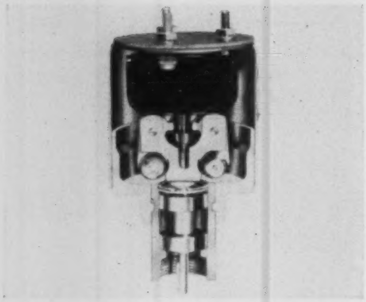
440 Series
Long Lengths

SD-333
Heavy Duty

Apex also produces magnetic tools, one-piece power bits, hand drivers and other types of tools to drive Phillips screws and bolts.

APEX FASTENING TOOLS
SCREWDRIVING • NUT RUNNING • SPECIAL
The APEX Machine & Tool Co. • 1036 So. Patterson Blvd. • Dayton 2, Ohio

Circle 706 on Page 17



Speed Sensitive Switch

Item 462

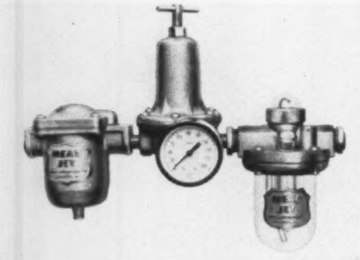
Speed sensitive switch operates on the governor flyweight principle to provide overload protection. It is applicable wherever it is necessary to operate a set of electrical contacts at a predetermined speed between 250 and 5000 rpm and the normal running speed is above the trip point. The contacts are snap acting and can be used to open or close a circuit. Overload protection is accomplished by adjusting the unit to trip its contacts slightly below normal running speed. **Synchro-Start Products Inc.**, 8151 N. Ridgeway Ave., Skokie, Ill.

Circle 462 on Page 17

Air Line Control

Item 463

Air-operated equipment consists of a filter, lubricator, and pressure regulator. In the lubricator, the acceleration of air passing through a venturi forms the oil mist. This design permits easier adjustment for both high volume and low volume air supply. An oil manifold maintains a starting supply of oil in the nozzle and with the first puff of air through the line, mist is delivered. Other features of the lubricator include: Less restriction of air flow; the oil supply and oil flow is visible from all sides; oil can be added from both sides; and there are separate adjustments for air flow and oil flow.



Oversized air passages and a diaphragm chamber separate from the air passage permits the pressure regulator to adjust and maintain the desired air pressure without materially reducing the flow. The regulator can be taken apart for service without disconnecting the air line, and the gage can be attached on either side. The automatic filter is suitable for all applications where the air flow is intermittent. It expels moisture and other impurities whenever the air flow is interrupted or changed. The filter can also detect leakage in the air line. When there is a leak, the diaphragm flutters, attracting the attention of the operator. Unit is available in 1/4, 3/8, and 1/2-inch pipe sizes, for air line pressures up to 250 psi. **Mead Specialties Co.**, Dept. R-46, 4114 N. Knox Ave., Chicago 41, Ill.

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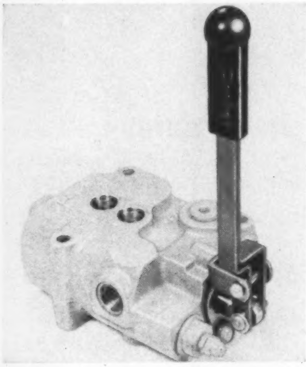


Hydraulic Control Valve

Item 464

Line of manually operated one-spool hydraulic directional control valves is available in three capacities with nominal ratings of 12, 20, and 40 gpm. An integral check valve prevents load drop when changing spool operating positions. This valve is externally adjustable. Another feature is the low pressure drop which provides precise positioning, smooth starting and stopping, or stepless control of speed in the mechanism. The valves are recommended for maximum working pressure of 2000 psi. **Parker Hydraulics Div., Parker-Hannifin Corp.**, 17325 Euclid Ave., Cleveland 12, Ohio.

Circle 464 on Page 17

SPECIFIC for Braking • Actuation • Control

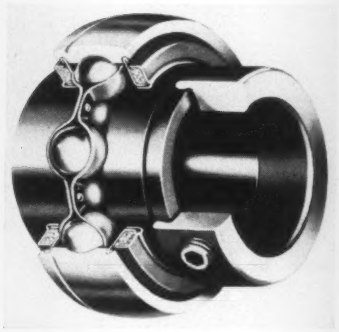
WAGNER SYSTEMS applied by
Experienced Application Engineers
COMPLETE . . . CONVENIENTLY PACKED

Don't just guess about the parts you need . . . Look to Wagner for numerous air and hydraulic systems to supply the muscle power for: FAIL-SAFE emergency braking . . . HIGH CONTROLLED force actuations . . . REMOTE CONTROLLED system actuation. Your Wagner Systems Engineer is backed by many years of experience in braking and control system design. Call him today.

W159-3

WAGNER ELECTRIC Corporation
6400 Plymouth Ave.
St. Louis 14, Mo.

Circle 707 on Page 17



Ball Bearing

Item 465

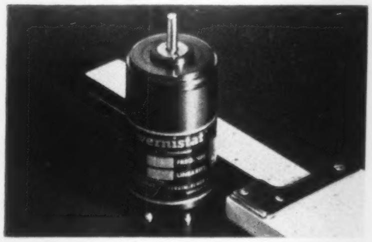
Equipped with a spherical seat for automatic self-alignment, unit is designed for adaptation to all types of housings requiring self-contained ball bearings. The collar, which secures the unit to the shaft, is a self-tightening, eccentric type that provides positive locking at installation. A three-piece combination felt seal in the unit retains the lubricant and excludes contaminants. The bearings are available in 32 shaft sizes from ¾ to 2-15/16-inch. **Hoover Ball & Bearing Co.,** 5400 S. State Rd., Ann Arbor, Mich.

Circle 465 on Page 17

Precision Potentiometer

Item 466

Applicable in servo systems, control systems, and analog computers, miniature potentiometer is 1.0620 inch in diameter, weighs 2 ounces. It is available with maximum output impedances of 200, 100, and 40 ohms, combined with high input impedance, and low output quadrature. Minimum output voltage increment (resolution) is 0.01 per cent, and terminal linearity is 0.05 per cent. Unit is also furnished in nonlinear versions with 30-chord accuracy. **Vernistat Div., Perkin-Elmer Corp.,** Norwalk, Conn.

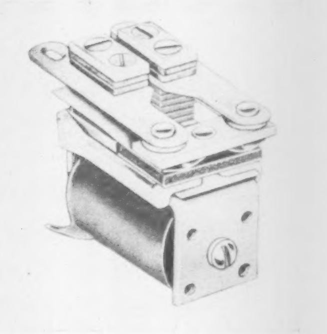


Circle 466 on Page 17

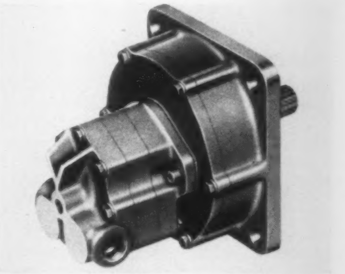
Miniature Contactor

Item 467

Device is capable of switching loads up to 60 amp with control signals as small as 2.7 w. Model MB can handle starting surges up to 150 amp for 300 milliseconds. A double throw version of the relay can be furnished with contacts derated to 20 amp. Unit can also be furnished to operate under shocks of 30 g and 10 g vibrations to 500 cycles. Tests from 10 to 55 cycles at 0.065-inch displacements fail to open the contacts. **Potter & Brumfield Inc.,** Princeton, Ind.



Circle 467 on Page 17



Hydraulic Motor/Reducer

Item 468

Unit combines a gear type fluid motor which is mounted as a part of a planetary gear reducer. Device can be used in driving rotary soldering, welding, or heat treating fixtures; powering hoists, cranes, or rope drives; turning turrets and platforms; and driving elevators and conveyors. Motor has a reduction ratio of 4.6:1 to provide a smooth output even at low shaft speeds. When used with an oil source capable of providing 1500 psi, 150 lb-ft of output torque is furnished. **Webster Electric Co.,** Racine, Wis.

Circle 468 on Page 17

STROMBERG-CARLSON
TELEPHONE HANDSETS

. . . for your voice communication needs.

These "push-to-talk" handsets are of the most modern design available.

If your applications are in **• mobile radio • intercom systems • carrier and microwave • aircraft and railroad** — specify Stromberg-Carlson handsets.

No. 26: short, lightweight, sturdy. Comes with capsule-type receiver and transmitter.

No. 28: "push-to-talk" handset. Rocker-bar switch; various spring combinations.

Both models available with standard or high-gain transmitters and receivers. Superior to any other handset on the market.

Modern handset cradle
for mobile or panel use

Holds handset firmly; is strong and resilient; fits any Stromberg-Carlson handset. Switch combinations with two or four Form C contacts. Space for your company name is provided. Send for Handset Bulletin T-5005 and Cradle Bulletin T-5013. Write:

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A DIVISION OF GENERAL DYNAMICS CORPORATION
Telecommunication Industrial Sales
111 Carlson Rd. • Rochester 3, N. Y.
S-C

Circle 708 on Page 17

catalogs and literature

Latest automation information. For copies use card on page 17.

Servo System Components

Kearfott Co. Inc., Little Falls, N. J.—48 page catalog—Technical data are given on servo motors, tachometer generators, motor generators, and synchros for high performance servo systems. A list of symbols and abbreviations are defined and applications of the different units are noted. Test and measurement methods for determining synchro operating characteristics are also explained.

Circle 469 on Page 17

Rotating Components

Helipot Div., Beckman Instruments Inc., 2500 Fullerton Rd., Fullerton, Calif.—11 page bulletin—Data are contained in Bulletin 1583 on the use of inertia and velocity damped servomotors. Various forms of electromagnetic damping are compared, with details on the characteristics of each type. Transfer function equations are given to help in determining unit damping requirements. Charts list additional damping that can be provided in sizes 11, 15, and 18 inertial and velocity damped units.

Circle 470 on Page 17

Precise Remote Control

General Electric Co., Schenectady 5, N. Y.—16 page booklet—Selsyns and Synchros are described in Bulletin GEA-6675. The devices, which include generators, motors, control transformers, differential generators, and differential motors, are suitable for transmitting electrical angular data between two or more points. The data can be furnished in terms of precise mechanical positioning of a shaft, or as an electrical signal. Principle of operation is explained, aided by schematic drawings.

Circle 471 on Page 17

Pneumatic Materials Handling

Fuller Co., Catasauqua, Pa.—12 page booklet—Booklet is a reprint of a talk entitled, "New Developments In Pneumatic Materials Handling." It discusses how systems can be combined for better materials handling. Data are given on a pneumatic pump and its use as a skid-mounted unit for handling cement or as part of a semi-trailer for filling and discharging dry materials in bulk. Diagrams showing details of the various systems are included.

Circle 472 on Page 17

High Temperature Wires

American Super-Temperature Wires Inc., West Canal Street, Winooski, Vt.—64 page catalog—Catalog is divided into eight sections according to products, which include magnet wire, lead wire, cables, tubing, and Teflon tape. Specifications, physical characteristics, and temperature ranges are given; as are data on colors, tests, and wire and cable constructions. Prices and ordering instructions are noted. Also included is a discussion on bonding to wire and cable insulated with Teflon TFE-fluorocarbon resins.

Circle 473 on Page 17

Remote Weight Recording

Toledo Scale, Div., Toledo Scale Corp., Toledo 12, Ohio—8 page bulletin—Bulletin 2975a describes remote digital weight control and explains how transmitted weights are recorded and processed on adding machines, typewriters, tape punch or card punch units, or indicated in illuminated numerical form. One of the systems covered uses a Direct Digital Scanner which electronically transmits a continuous signal of weight being applied to the scale.

Circle 474 on Page 17

Adjustable Speed Drives

Dynamatic Div., Eaton Mfg. Co., Kenosha, Wis.—16 page booklet—Data are contained in Bulletin GB-3 on line of adjustable speed drive equipment which can be used in machinery, machine tool, paper, and metal processing industries. Units in the line include: Eddy-current couplings, drives, brakes, dynamometers, and magnetic friction clutches and brakes. Operating principles are discussed as are the electronic controls for regulating the eddy-current equipment.

Circle 475 on Page 17

Tube Fittings

Lenz Co., 3301 Klepinger Rd., Dayton 1, Ohio—20 page booklet—Line of hydraulic tube fittings and hydraulic accessories is described in Bulletin 259. Types include: O-ring seal fittings, flare tube fittings, and pipe fittings. Types of accessories include: Benders, tube cutters, tubing, valves, gages, filler caps, and installation tools.

Circle 476 on Page 17

Plastic Molding Machines

Hydraulic Press Mfg. Co., Div., Koehring Co., Mount Gilead, Ohio—6 page pamphlet—Machinery for molding plastics is outlined in Bulletin 5830-A. Types of machines include injection machines, compression, transfer, and reinforced plastics molding presses. Application photos are included.

Circle 477 on Page 17

DC Amplifier

Boston Div., Minneapolis-Honeywell Regulator Co., 40 Life St., Boston 35, Mass.—4 page pamphlet—Model 2HLA-4a, a dc amplifier with isolated differential input is the subject of Catalog B-C2HLA-4. Numerous applications are noted showing how the amplifier can be used in laboratory, production, and process control. Also included are block diagrams and outline drawings.

Circle 478 on Page 17

Double Crank Presses

Federal Machine & Welder Co., Warren, Ohio—12 page booklet—Straight side, double crank presses in capacities from 60 to 400 tons are described in Bulletin 52120. An outline of construction for the single geared, single and double crank presses is given. Schematic drawings show part location of the single end drive and twin drive for the double crank press type.

Circle 479 on Page 17

Electrical Motor Controls

Industrial Control Div., Arrow-Hart & Hegeman Electric Co., 103 Hawthorn St., Hartford 6, Conn.—28 page catalog—Electrical motor controls are outlined, which are suitable for use with single and polyphase, 60 cycle, 1800 rpm, 40C ac squirrel cage motors. Data are given on single phase magnetic starters, magnetic reversing starters, combination starters, and polyphase magnetic starters.

Circle 480 on Page 17

Position Transducer

Farrand Controls Inc., 4401 Bronx Blvd., New York 70, N. Y.—30 page handbook—A precision data element, designated Inductosyn, is the subject of Bulletin 312. The unit is capable of measuring and controlling angles or linear distances, using an inductive coupling between conductors. Operating principle in both the rotary and linear form is explained. Data are given on how the unit can be used in numerical control applications. Illustrative examples are shown.

Circle 481 on Page 17

Piping Flexibility Analysis

Fabricated Products Div., M. W. Kellogg Co., 711 Third Ave., New York 17, N. Y.—8 page bulletin—Computer methods of analyzing power piping designs is the subject of booklet entitled, "Piping Flexibility Analysis." A check list for making an accurate analysis is given and a flow chart shows the procedure of a comprehensive analysis as performed by an automatic computer. Other tables list the results and recommendations of various tests.

Circle 482 on Page 17

Electromechanical Components

General Electro-Mechanical Corp., 785 Hertel Ave., Buffalo 7, N. Y.—59 page catalog—Data are given in Catalog EM-1 on hysteresis clutches and brakes, friction clutches and brakes, magnetic particle clutches and brakes, and magnetic particle bidirectional actuators. Numerous dimensional drawings and performance charts are given. Also included is a discussion of tension control. Basic principles are covered and the two main classifications of tensioning—surface drive and core drive—are explained.

Circle 483 on Page 17

Automatic Packaging

J. L. Ferguson Co., Joliet, Ill.—6 page pamphlet—An automatic packaging production line which performs case opening, loading, and sealing operations is described in Bulletin 100-54A. Data are given on both the single and multiple tier case loader. Schematic drawings show different arrangements of installations.

Circle 484 on Page 17

Precision Potentiometers

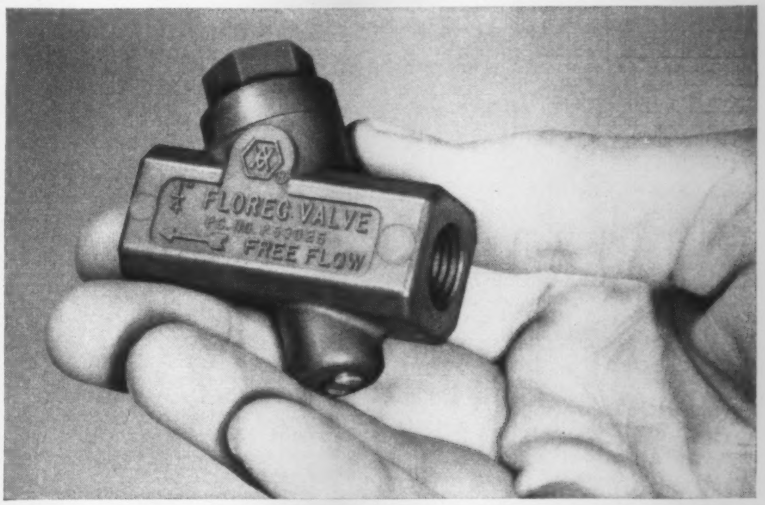
Electronic Sales Div., DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.—28 page catalog—Data are contained in Bulletin 359 on single turn, precision wirewound potentiometers in diameters ranging from ½-inch micro-miniature to 5-inch high resolution. Outline drawings show actual size and construction of some of the units. Characteristics, applications, and specifications for the different models are given.

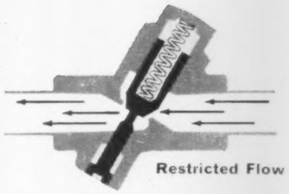
Circle 485 on Page 17

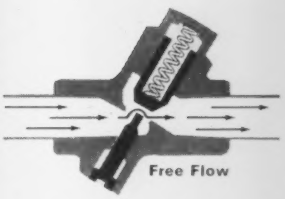
Auxiliary Tape Processing Units

Dykor Div., Digitronics Corp., Albertson Ave., Albertson, L. I., N. Y.—4 page pamphlet—Auxiliary tape processing equipment for use in off-line testing, editing, copying, interrogation, and translating of

New Westinghouse FLOREG Valves for accurate flow control of gases and liquids




Restricted Flow


Free Flow

The new Westinghouse Floreg Valve accurately controls the rate at which a gas or liquid can flow in one direction through the circuit, yet allows free flow in the opposite direction. It works with other components of a fluid circuit to time, to sequence or to co-ordinate the operations of the circuit.

Chief Advantages

Easily adjustable in minute steps to full flow.

Greater capacity, lightweight and compact.

Consistent flow regulation: Single flow passage eliminates leakage encountered in separate check valve design.

Corrosion resistant: Made of aluminum, stainless steel and plated steel parts. Seals are oil-resistant.

Working pressure: 250 psi maximum pneumatic, 500 or 2000 psi maximum hydraulic.

Easily inspected and maintained: No need to break circuit connection.

Operating temperature range: —40 ° to 200 ° F.

Three sizes: ¼", ⅜", and ½", N.P.T.

Prices start at $4.00 on the ¼" size weighing 2.5 ounces.

Applications

... In the delivery line to a cylinder to control its piston speed.

... In material processing to time operations.

... In material handling to co-ordinate movement.

... In the speed line of a diesel engine to control acceleration rate.

See the yellow pages under cylinders for the name of your local distributor

WESTINGHOUSE AIR BRAKE COMPANY
Industrial Products Division, Wilmerding, Pennsylvania

Circle 709 on Page 17

magnetic tape files is described in Bulletin TPG 39. The "building block" construction is explained and power requirements noted.

Circle 486 on Page 17

Weighing and Batching

Jeffrey Mfg. Co., 956 N. Fourth St., Columbus 16, Ohio—56 page catalog— Weighing, batching, and proportioning systems which automatically deliver bulk materials in predetermined quantities are described in Catalog 841. Data are given on constant weight feeders, electric vibrating feeders, bin level indicators, and vibrating mixing conveyors. Illustrations show the different types of electrical controls and panels and also a glass batch proportioning system.

Circle 487 on Page 17

Servo Motors

Avionic Div., John Oster Mfg. Co., 1 Main St., Racine, Wis.—20 page catalog— Data are contained in Bulletin 5000 on line of servomotors for scientific, military, and industrial applications. Physical, electrical, and mechanical characteristics are noted and drawings show motor and shaft dimensions and circuit diagrams. Charts list performance curves.

Circle 488 on Page 17

Automatic Analyzers

Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa.—8 page bulletin— Analyzers for quantitative process stream control through automatic colorimetric methods are described in Bulletin 1156-1. The analyzers can be used for dissolved silica, dissolved oxygen, hydrazine, residual chlorine, total iron, phosphates, fluorides, copper, and sulfites. A schematic diagram shows how an analyzer uses pneumatic programming and null-balance electronic measuring circuit for a dissolved oxygen recorder.

Circle 489 on Page 17

Programmed Machine Tool

*Kearney & Trecker Corp., 6784 W. National Ave., Milwaukee 14, Wis.—23 page booklet—*An automatic multimachining center for producing small-lot parts (either alike or different) is described in Bulletin WS-59. Booklet entitled, "How to Evaluate Milwaukee-Matic," dicusses various processes such as management strategy, manufacturing system comparisons, and machine performance features. Points covered include estimating production time, estimating machine cycle time, and determining setup time for tape controlled machine tool capable of drilling, milling, reaming, tapping, and boring operations.

Circle 490 on Page 17

Pressure-Sensing Conveyor

*Rapids-Standard Co. Inc., Rapistan Bldg., Grand Rapids 2, Mich.—4 page pamphlet—*A pressure-sensing conveyor with adjustable pressure control is the subject of Bulletin 1200-59. Features such as positive control of accumulated carton pressure and automatic carton spacing are noted, aided by block diagrams.

Circle 491 on Page 17

Remote Control Automatic Valve

G & H Products Corp., 5718 Fifty-second St., Kenosha, Wis.—8 page bulletin— Automatic valves, suitable for use in the food processing or chemical industries, are described. An automatic system using remote control valves is shown and dimensional drawings of the different valves are given. A line drawing shows a typical valve hookup. The stainless steel valves are easily disassembled for servicing or replacement of O-rings.

Circle 492 on Page 17

Miniature Pneumatic Devices

*Clippard Instrument Laboratory Inc., 7390 Colerain Rd., Cincinnati 39, Ohio—4 page pamphlet—*Miniature air cylinders, valves, valve operating solenoids, fittings, and accessories suitable for automatic circuits or semiautomatic tooling and control applications are outlined in Bulletin 4-59. Bore sizes, styles, mountings, and voltages are noted.

Circle 493 on Page 17

Remote Control Unit

*I-T-E Circuit Breaker Co., 1900 Hamilton St., Philadelphia 30, Pa.—4 page pamphlet—*A motor-driven electrically operated mechanism, designated Telemand, which provides for remote control of molded-case circuit breakers, is the subect of Bulletin 5047-1A. Unit can be used in switchboards, control centers, or individual enclosures. Drawings display principal operator dimensions and a wiring diagram shows details of electrical connections and the different control options available.

Circle 494 on Page 17

Transistor Voltage Breakdown

Valor Instruments Inc., 13214 Crenshaw Blvd.. Gardena, Calif.—4 page pamphlet —Voltage breakdowns and their effect on transistors are discussed in Vol. 1, No. 1 of company publication. Five types of voltage breakdowns are described—avalanche breakdown, alpha multiplicaton, punch-through, thermal runaway, and miscellaneous breakdowns. Three leakage currents which are related to voltage breakdowns are also defined.

Circle 495 on Page 17

Electrical Installation

*Gustav Hirsch Organization Inc., 1347 W. Fifth Ave., Columbus 12, Ohio—16 page booklet—*Data are given on company's electrical and communications engineering and construction. Projects on super highways, educational and public institutions, and power plant construction are discussed. Also included are notes on other assignments in Alaska, Spain, Brazil, and Panama Canal.

Circle 496 on Page 17

Directional Air Control Valves

Hannifin Co., Dept. 142, 501 S. Wolf Rd., Des Plaines, Ill.—12 page booklet— Data are contained in Bulletin 234 on line of 2-way, 3-way, and 4-way directional air control valves. An outline covering valve types, means of actuation, and operating principles is given to help select

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Circle 710 on Page 17

the control valve best suited for an application. Also included is a glossary of valve terms.

Circle 497 on Page 17

Electrical Connectors

Crouse-Hinds Co., Syracuse 1, N. Y.—48 page catalog—Line of plugs and receptacles, which has a high resistance to alkalis, strong caustics, acids, petroleum base and organic solvents, is described in Bulletin 2711. The units are designed to operate in a temperature range of −80 to 225 F and can withstand pressure of 300 psi external and 200 psi internal. Construction characteristics are explained and drawings show the selection of interchangeable components. Instructions are also given for assembling the units.

Circle 498 on Page 17

Switchboard Instruments

Roller-Smith Inc., 50 Avenue L, Newark 1, N. J.—24 page catalog—Switchboard instruments such as ac ammeters, ac milliammeters, ac voltmeters, ac frequency meters, dc voltmeters, dc millivoltmeters, and temperature indicators are described in Catalog 4220. Data on mechanical types, accuracy, scale length, rating, terminals, dimensions, and weights are given. Details are also given on design and construction features of pivotal bearings, springs, armatures, and cases.

Circle 499 on Page 17

Power Transmission Products

American Stock Gear Div., Perfection Gear Co., Harvey, Ill.—223 page catalog—Data on line of stock gears are given in Catalog 360. Items in the line include: Spur gears, internal gears, miter gears, bevel gears, ladder chain sprockets, thrust washers, flexible couplings, universal joints, and worm gear speed reducers. Photos show the styles of the different gears. Also included are tables listing hp ratings for speed reducers.

Circle 500 on Page 17

Centralized Control Systems

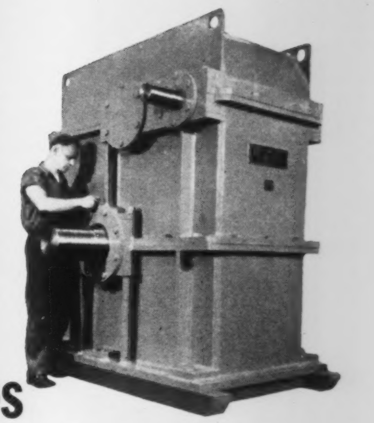
Protection Controls Inc., 6000 N. Legett Ave., Chicago 46, Ill.—4 page pamphlet—Packaged units which combine sequencing, supervising, indicating, and power controls are outlined in Bulletin 159. Applications on automatic machinery, drying, baking, food processing, and materials handling systems are noted. Safety and maintenance features are also mentioned.

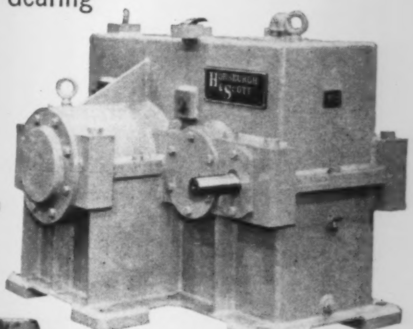
Circle 501 on Page 17

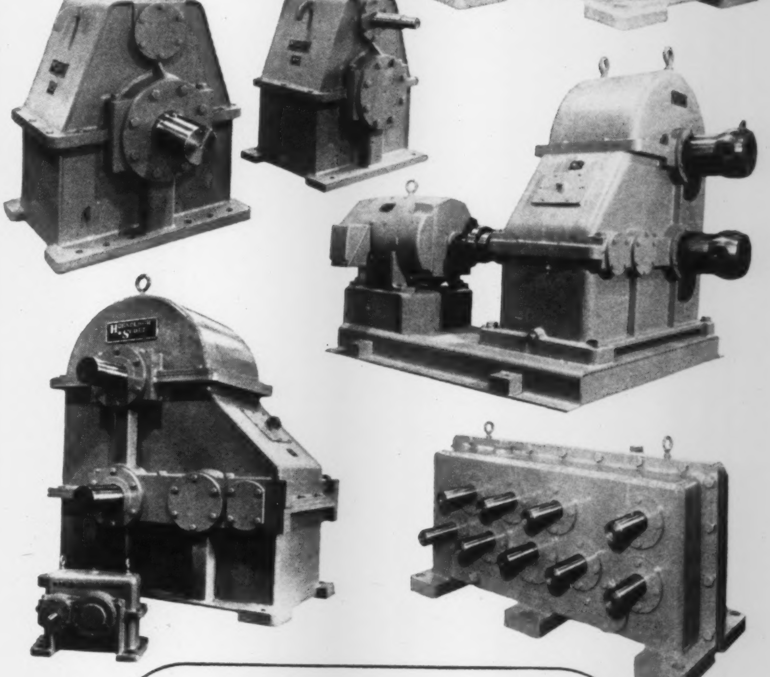
Hydraulic & Pneumatic Cylinder

Petch Mfg. Co., 463 York St., Detroit 2, Mich.—16 page booklet—Line of hydraulic and pneumatic cylinders is described in Bulletin 8a. Features, applications, and ordering instructions are noted. A new concept in hydraulic valve panel fabrication with building block components is discussed. Data are also given on related products such as boosters, air-oil tanks and cylinders, oil tank level gages, and flash welder control valves.

Circle 502 on Page 17







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Circle 711 on Page 17

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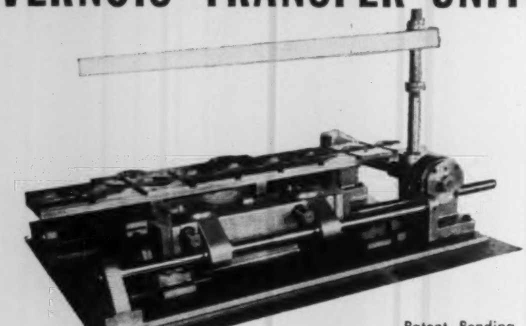

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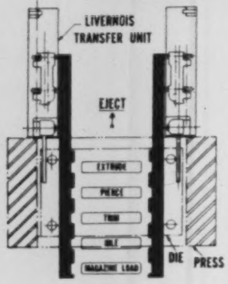

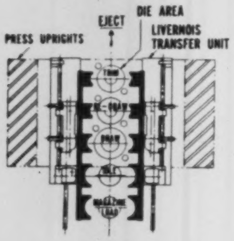

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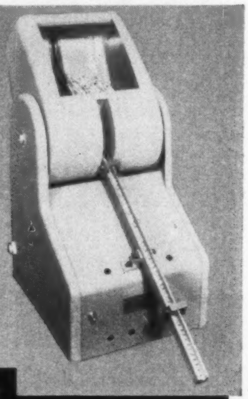

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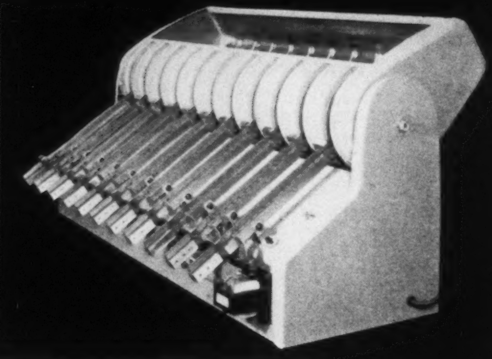

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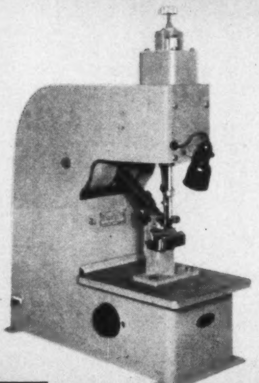

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AUTOMATION abstracts

TAPE CONTROLLED TARGET DRILL PRODUCES INTRICATE HOLE PATTERNS

AUTOMATIC tape control of machine tools is in wide use in such areas as the manufacture of small parts and dies. Among heavy-equipment manufacturers, however, ALCO Products Inc. is one of the first to adopt the tape method. It is used in target drilling of large, precision tubesheets for heat exchangers and feedwater heaters. The automatic tape system overcomes many of the problems of precision, reliability, and repeatability which were common in manufacture of this equipment.

Former Method

Before going to the new system for automatic, horizontal tubesheet drilling, ALCO had used the vertical radial drilling method. More time-consuming from the outset, the old system required the transfer of the entire tube-hole pattern to drawings, which the machine operator then transferred to the tubesheet blank by "spotting" each hole and calculating any bridges required from a master tube pattern bar jig. The procedure of vertical radial drilling of tubesheets had been in use for years. It not only was too slow but also had too large a margin for error.

Another factor arose to stimulate the quest for a modern technique: As design pressures in power stations and process plants increased, a corresponding demand for heavier thermal equipment to withstand these pressures also developed. In heat exchangers and feedwater heaters, one result was that tubesheets became thicker, and consequently harder to drill. The same is true for components built for nuclear powerplants and atomic propulsion systems.

Acquiring Tape Control

As a first step in modernizing the tubesheet drilling operation, machine tool companies and firms specializing in automatic tape-control equipment were consulted on the possibility of adapting new target drilling machines to automatic control. After intense study, such an application was found feasible, and two machines, complete with tape controls, were purchased and set up in ALCO's key heat exchanger plant at Dunkirk, N. Y. The machines have proved valuable beyond all expectations.

In addition to the all-important automatic feature of the tape control, which eliminates manual indexing formerly necessary in conventional target drilling, the new machines perform flawlessly under all factory conditions. Almost immediately, they began turning out tubesheets with holes drilled consistently to accuracies of 0.001 to 0.0015-inch per foot of drill depth. This is in contrast with the

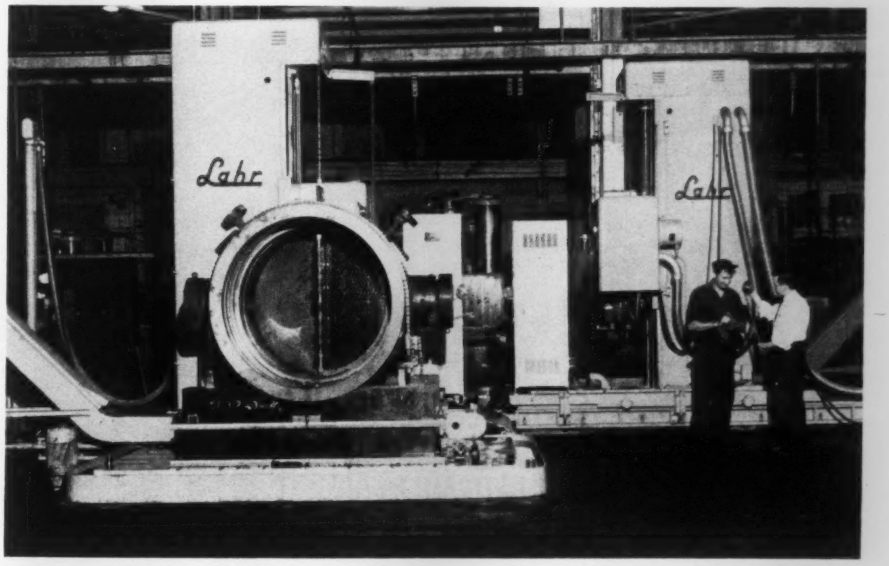

Fig. 1—Two Lahr Machine & Tool Corp. deep-hole target drilling machines are used for drilling 3/16 to 1¼-inch diameter holes in tubesheets to depths up to 24 inches. Tape controls on each machine position drillheads and cycle machine actions to produce predetermined patterns of holes.

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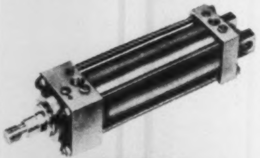

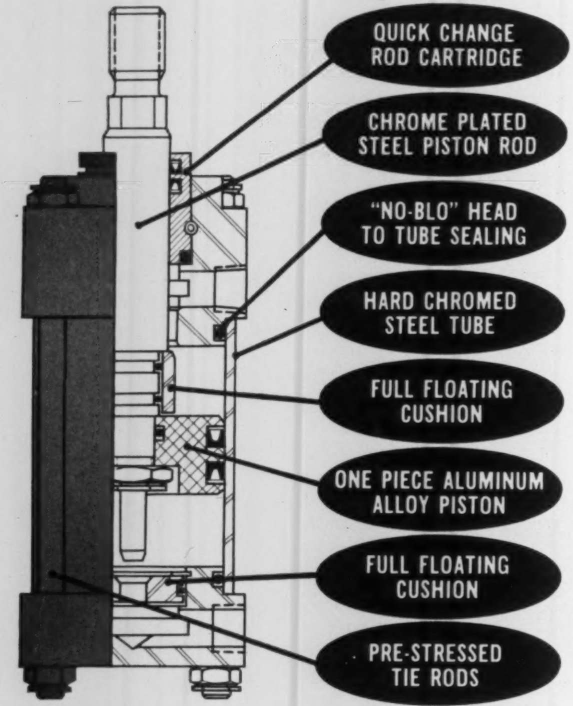
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former drift accuracies attained—from 0.004 to 0.006 inch drift in depths of 9 to 10 inches. Under the new method, the stated drift accuracy can be held in depths up to 24 inches—greater than the thickness requirements of tubesheets in existing design conditions.

The present equipment, *Fig.* 1, consists of two Lahr Machine & Tool Corp. deep-hole target drilling machines designed for spindle speeds from 300 to 5000 rpm, with positioning range of 6 feet in both vertical and horizontal directions. A Warner & Swasey Research Corp. Pilot Probomat system reads the automatic tape which controls the positioning of the target drilling machines.

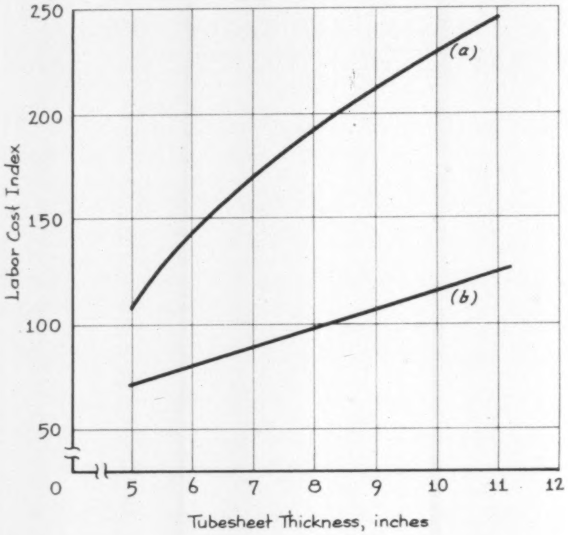


Fig. 2—Curves illustrate relative labor costs for drilling multiple holes in tubesheets of different thicknesses by two methods. In old method, (a), radial drill was positioned manually over tubesheet that had hole pattern laid out on its surface. In tape controlled target drilling method, (b), drill is automatically positioned with respect to workpiece. Other advantages of tape control include greater precision and less chance of error.

Operation of Controls

The Probomat system is designed as an attachment to existing machine tools as well as incorporation in original equipment. It operates as follows: All control information—the commands as well as decimal co-ordinate dimensioning—is coded on 8-hole Flexowriter tape. The control signals are transmitted from the tape to a pilot unit for each carriage motion. Each pilot unit has a peg-and-pawl slide. This slide is attached to the machine tool in such a way that the slide travel parallels that of the machine tool carriage

Circle 714 on Page 17

to be controlled. The peg-and-pawl slide has a small pilot carriage of its own which is actuated through tape control to assume any desired position as indicated by the drawing dimensions of the part. For each movement, the pilot carriage moves under tape control to the predetermined position, and the machine carriage then follows. The latter is stopped automatically where indicated by the pilot. At this point, in the case of tube-hole drilling in tubesheets, drilling may commence. When a hole is completed, the same process is repeated until the entire tubesheet is drilled.

The steps required to prepare and use a control tape for tubesheet drilling are:

1. Receive initial application requirements from customer.
2. Study application and decide on approximate part design.
3. Feed thermal design input into a computer to obtain complete rating data and definition of tube-hole pattern.
4. Utilize previously prepared IBM computer program to automatically determine tubesheet co-ordinates and directions of drill travel.
5. Process output from computer and feed to an IBM card-to-tape converter.
6. From an initial indexing, the tape is locked-in and begins to operate target drill with jig-borer accuracy.
7. Upon completion of tubesheet drilling, tape may be filed for possible use on identical units if ratings permit.

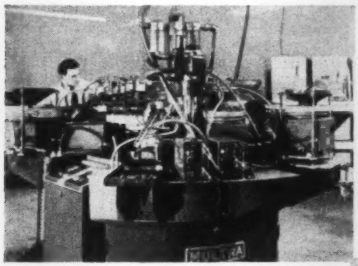
A feature of this system is the speed of preparing tapes for any new or modified tubesheet layouts. Tape control also avoids many intermediate tooling steps and the storage areas for such tools. It eliminates material handling and other auxiliary services normally needed in older methods.

In the application of automatic tape control to precision target drilling machines, ALCO has attained a method of producing tube holes which meet the most exacting requirements. Restricted hole-to-hole ligament tolerance, coupled with close-tolerance hole sizing in tubesheet drilling, always has been a critical and costly requirement. However, with the new tape-target drill method, allowance in ligament thickness to compensate for drift is unnecessary. A labor cost comparison for drilling holes in tubesheets with a radial drill and with the target drilling system can be made from the two curves in *Fig.* 2.

Many tubesheets have been produced since the installation of the new system several months ago. In addition, nuclear components such as pressurizers and steam generators have been drilled by the new process. Some of these components contain heater-well holes which require drilling tangentially to shells.

An automatic tape system plays an important part in manufacturing. It eliminates costly errors possible in the previous "visual layout" method of target drilling, and provides the full accuracy demanded. Just as the computer can release the engineer from many of the tedious and routine functions of his profession, so

WHAT'S YOUR ASSEMBLY PROBLEM?



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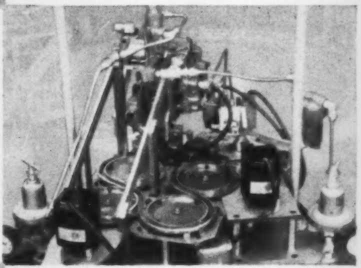

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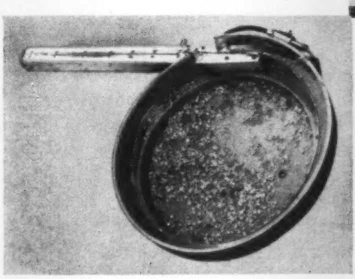

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Circle 716 on Page 17

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Circle 717 on Page 17

can an automatic tape control system enable a manufacturer to devote his efforts to refining his products and improving his manufacturing techniques.

From an article entitled "Through a Half-Mile of Steel at ±0.001" which appeared in the ALCO Review, Summer-Fall, 1958, and material supplied by ALCO Products Inc.

RACE TRACK AUTOMATION

By O. C. LEVY
Vice President
American Totalisator Co.
Towson, Md.

AUTOMATION—and automatic processes in general—must seem like strange bedfellows for horses. Yet many of the developments in automatic and remote control devices have been applied to establish and maintain the dominance of the horse in the sporting world. Horse racing is today the leading spectator sport of this country, catering to an attendance of over 53 million persons annually. A large share of the credit for this achievement should go to the engineer, whose devices have earned the confidence of the public.

There are probably very few among the spectators at a modern race track who give any thought to the variety of engineering skills that are called upon to produce a show that is at once entertaining, honest, and impartially operated.

Timing and Recording

Every race starts from a starting gate, an ingenious framework of stalls equipped with electrically latched gates. The simultaneous opening of all the gates by the starter assures a uniformly quick and fair start for every race.

As the horses run down the track, they are automatically timed by a device which is triggered from photoelectric cells located at the starting line and at every ⅛-mile pole. These are so connected that the cumulative running time for the ¼-mile, ½-mile, and ¾-mile intervals, as well as the final time of a race, are all displayed instantaneously to the public by large electric lamp monogram indicators.

Human judgment of the order of finish of a race has been supplanted by the record of the photofinish camera. As originally introduced, this was a motion picture camera taking approximately 100 frames per second, about the limit of speed at the time for the lighting conditions at the track. At this speed, however, there were several inches of motion between successive frames, and it was not possible to insure that the winning horse would be photographed with his nose exactly at the finish line. This problem was solved by the introduction of the shutterless, slit-type camera which, in effect, photographed the time succession of events at a fixed point in space—the finish line. Here, incidentally, an early attempt at race track automation failed, when a camera incorporating automatic processing of the exposed film proved to be slower and more expensive than a manual processing system.

It is not only the finish of a race which is photographed. Every second of the running action is recorded by a number of cameras, whose films provide the stewards with indisputable evidence of any rough or foul riding actions. These films are developed in a high-speed processing tank to be available for showing in a matter of 8 or 9 minutes after the finish of a race. In many cases, closed circuit television is used to flash the pictures to the stewards in their office on the grandstand roof. Today, with the development of video tape, experiments are under way to apply this latest development to provide immediate playback of the running of a race.

Data Processing

All of these devices, however, while valuable contributors to the establishment of public confidence in racing, are secondary to the totalisator. The American Totalisator is basically a data-processing system, whose successful introduction in 1933 marked the beginning of a mechanical revolution in horse racing. Prior to that time, betting on horse races was conducted by the manual sale of preprinted tickets. This was unsatisfactory for many reasons. It was impossible, with human means, to gather interim figures during the sale of tickets and to total those figures in time to provide accurate information on the changing odds for the guidance of the bettors. Betting had to be closed five minutes or more before the start of a race in order that a reasonably satisfactory line of final odds could be posted, and even then the unsold tickets on winning horses had to be guarded very carefully. Because of these conditions, and with no information provided as to the amounts of money bet on the different horses, public confidence was so lacking that racing was struggling for its very existence.

The totalisator provided the answer to all of these problems by furnishing a system of ticket printing and issuing machines, connected through a maze of wiring to a group of electrical adding machines, whose accumulated totals were constantly displayed to the public by electrical indicators. Since the tickets were printed only as they were issued, there was no problem of guarding unsold tickets. Further, the printing of the ticket was made dependent upon the receipt of a check-back signal showing that the corresponding bet had been recorded. This enabled the printing of tickets to be positively stopped at the end of the betting period by electrically locking the adding machines, thereby guaranteeing to the public that no unauthorized tickets could be issued.

With the amounts bet on each of the horses, as well as the total of all the amounts bet, constantly and instantaneously available, it became possible to show accurate interim odds quotations at frequent intervals. This also made it possible to extend the betting period up to the very moment that the race was started, since the final betting figures were instantly available upon the close of betting.

It was necessary that the totalisator accept and total bets in denominations of $2, $5, $10, $50, and $100 on each of 12 entries, displaying the accumulated amounts in dollars for each of the entries, as well as

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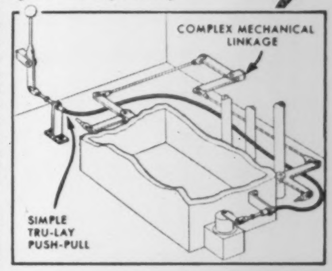

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Circle 720 on Page 17

the total of all 12 entries. Further, since bets could be made for Win, Place, or Show, that is, for first, second, or third in order of finish, this required the provision of three such totalisators. Speed of operation was also essential, so that a minimum of 150 ticket issuers could be used, each issuing a ticket only under control of the proper adding machine, but without slowing the sale of tickets. It was, of course, also necessary that the 150 machines be enabled to sell without interference or the possibility of errors resulting from the simultaneous operation of keys on all machines. The totalisator thus provided a fully automatic operation, from the pressing of a key by a ticket seller to the final public display of the amount bet.

Portable and Reliable

Public reaction to the improvements brought about by the totalisator was immediate, and racing entered upon a period of rapid expansion. This growth brought with it fresh problems. Because of the high cost of the equipment required at a track, it became necessary to redesign the units for complete portability. This made it possible to use a single set of equipment at more than one track, thereby making the use of the totalisator economically feasible at even the smaller tracks.

Every piece of equipment was made to be easily plugged into the terminals of permanent wiring at each track. Today, a modern race track may require nearly 500 ticket machines, more than 1000 electric lamp monogram indicators, and 39 totalisator adding machines, plus auxiliary equipment, batteries, and generators amounting to a total weight of 200,000 pounds. This vast quantity of equipment can be removed and packed aboard trucks within a few hours after the close of racing, moved many miles, and set up at another track to be ready for racing early the next day.

Such portability makes great demands upon the ruggedness and reliability of the system and its components. The conditions of racing also require extreme reliability, since downtime cannot be tolerated when a crowd of perhaps 100,000 people must be enabled to bet as much as $1 million in a period of 40 or 45 minutes. These requirements have been met by the use of the highest quality, extremely rugged, telephone-type relays and stepping switches. All wire connections are securely wrapped, as well as soldered, for protection against the effects of vibration during moves. All relay groups have enclosures which are reasonably dust-tight, while still readily removable for quick maintenance. In addition, an elaborate alarm system supervises all major functions and provides a quick analysis of trouble conditions so that a defective unit may be replaced with only a minor interruption to betting. A detailed program of preventive maintenance, coupled with a 100 per cent check of all elements of the system during the pre-race hours, has given the system a highly satisfactory service record.

Computing Functions

The complete pari-mutuel operation at a race track requires more than just the basic adding machine function of the totalisator, for the odds and the prices of winning tickets must be computed. The automatic process has been extended to cover these functions by the design of two computing units, each capable of taking its basic data directly from the totalisator.

The automatic odds-computer is an analog type which has been in use since 1947. It takes digital information from the totalisator as to the amounts in the total pool and on each entry in succession, making allowance for the percentage of the total pool retained by the track and state, and computes the odds ratios as digital outputs in discrete steps. The computer is also provided with a memory section and simple arithmetic unit to take care of a situation where the late scratching of an entry requires the refunding of bets made upon it. In this case, the total pool shown is too high by the amount of the refund, and must be adjusted for the computation of the correct odds.

The simple operation of a key corresponding to the number of the scratched entry changes the programming of the computer to cause it to read from the totalisator and store in its memory the amount of the refund. Thereafter, on every cycle of odds computing, the refund is automatically subtracted from the total pool shown by the totalisator, and the net difference is used in the computation.

The automatic price computer is a small digital electronic computer which functions automatically at the close of betting to read from the totalisator and store in its memory the 39 sets of figures covering the bets in all three pools. It verifies the addition provided by the totalisator and prints out the complete set of figures to permit a visual check of the correctness of the input data. At the end of the race, the successive manual entry of the numbers of the first, second, and third entries causes the computer to select the proper data from its memory and to figure the corresponding prices. In each pool, it prints out a complete record of the total pool, the commission deducted for the track and state, the net amount of money to be paid out by the cashiers, and the breakage, which is the amount left by virtue of the rounding off of the price to the next lowest nickel or dime. It also prints out all of the $2, $5, $10, $50, and $100 Win, Place, and Show ticket prices, together with the prices of the combination tickets.

A final step in the provision of completely automatic operation has been the provision of an automatic read-out unit. This unit scans the indicator board on every display cycle and prints out a full record of the odds and amounts bet.

Sizing and Servicing

The totalisator is produced in models with different capacities, ranging in size from the largest, which includes four cabinets each 7 feet long by 6 feet high and 2 feet thick, down to a small track unit housed in a single cabinet only 24 inches by 15 inches by 10 inches. To service all of the race tracks, it is necessary to move the equipment a total of 2,500,000 ton-miles, while over 300 technicians travel approximately 1,500,000 miles during the course of a year.

From a talk entitled "Automating the Horses" presented at the Third Conference on Manufacturing Automation co-sponsored by Purdue University and AUTOMATION *magazine, March 1959.*

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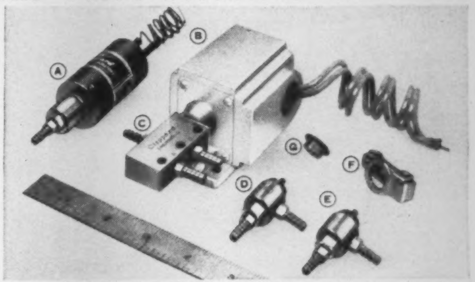

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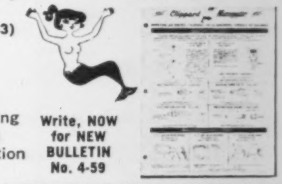

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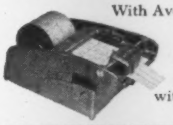

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CASE 1823-P

pH SAMPLING

. . . We have a material with possibly a 14 to 15 per cent moisture content. Essentially it is still quite dry and dusty. We would like to make continuous pH recordings as it goes through a production line. Various manufacturers are able to supply equipment to sense and record pH. Our difficulty, however, comes in obtaining samples, adding water, and then disposing of them. It would be necessary to use only about one gram of material to 10 cc of water. We wonder whether or not someone may have licked this problem already. . .

Chocolate Processor

CASE 1830-P

STREAMLINING PAPERWORK

. . . I am working on a team that is investigating ways to streamline a paperwork cycle. The principal purpose is to cut the cycle time between the release of the engineering drawings and specifications and the commencement of operations in the shop. . .

Supervisor, Manufacturing Engineering

CASE 1833-P

TICKET PLACING

. . . We wish to place a 1 by 3 inch ticket in a bundle before it is overwrapped on a bundler such as a Scandia machine, or adhere the ticket to the outside of the bundle after it is kraft paper wrapped. . .

Chief Engineer

SUGGESTIONS FOR 1774-P (APRIL 1959)

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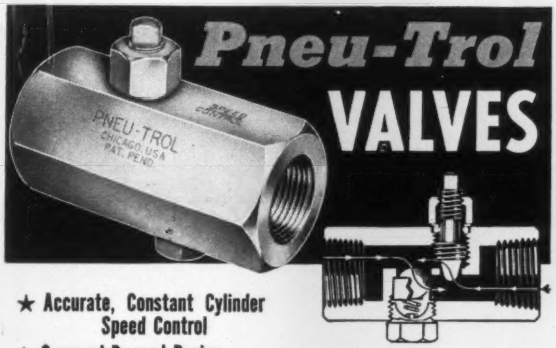

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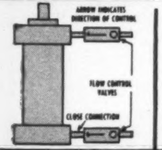

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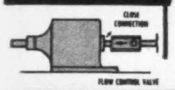

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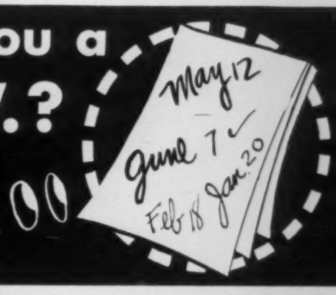

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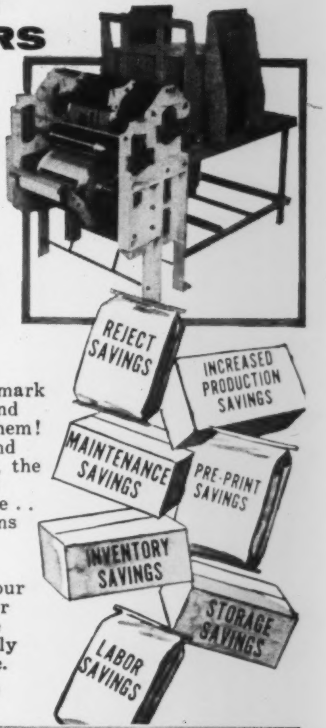

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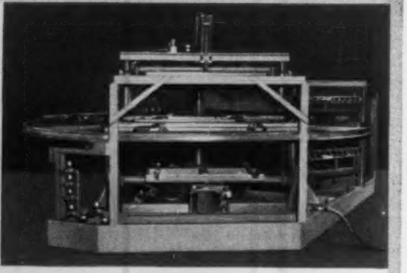

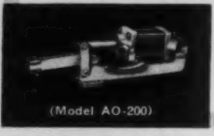

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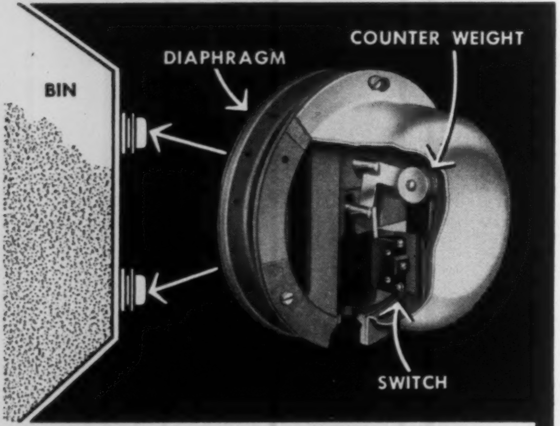

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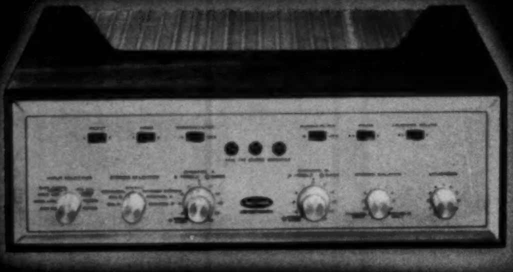
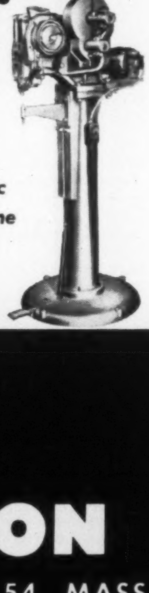


299 - H. H. Scott 40 Watt Stereo Amplifier

HI-FI QUALITY SECURED AT LOWER ASSEMBLY COSTS



Style 161
Thomson Automatic
Rivet-Setting Machine

Thomson Rivets and Rivet-Setting Machines used by H. H. Scott to standardize fastening procedures.

Any high fidelity hobbyist will tell you that H. H. Scott, Inc., Maynard, Mass., makes America's top quality in high fidelity equipment.

Here you see one of the finest stereo amplifiers made . . . in both chassis and final form. Components are securely and accurately held in uniform tension by 113 Thomson Rivets. H. H. Scott has standardized on Thomson aluminum rivets in one diameter and four lengths.

Rivets get their uniform clinch from any one of the eight Thomson Automatic-Feed Rivet-Setting Machines which H. H. Scott now uses.

All eight machines have identical tooling except for interchangeable anvils. Several sets of numbered, color-coded anvils cover all variations in assembly thickness. Change-over time is a matter of seconds.

E. G. Dyett, Jr., Purchasing Agent of H. H. Scott, reports, "The use of Thomson rivets and rivet-setting machines has produced assembly economies and resulted in lower over-all costs, while improving product appearance and mechanical construction."

Chances are the Thomson Fastening Man can help you improve product quality and reduce your costs. It costs nothing to find out. Make a date with him soon. You'll find him listed in the yellow pages of your phone book. In the meantime, you'll want Thomson's latest catalog. Write today for your free copy to Dept. A

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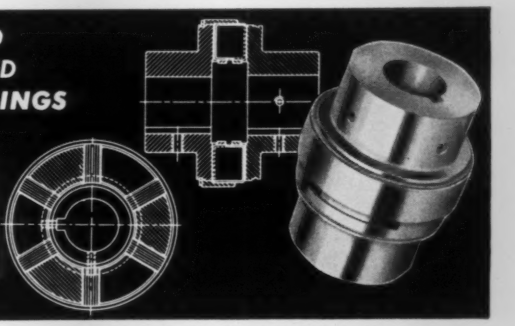
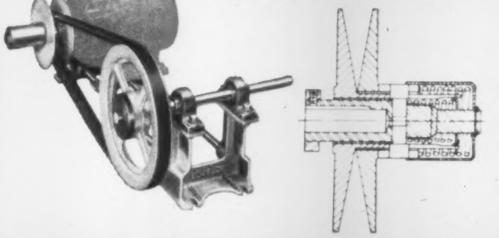
Bores (max.)......5/16" to 9½"
O.D. ....⅝" to 21½"
Wt. ....½ oz. to 1500 lb.
H.P. ....1/20 to 3000
Torque (static)..1½ to 5100 ft.-lbs.



MAINTENANCE-FREE INSTANTLY-ADJUSTABLE **VARIABLE SPEED PULLEYS**



Bores (max.)......½" to 1⅝"
O.D. ....3" to 13⅝"
Belt Sizes........A to 2¾ TW
Speed Ratios.......1-1 to 8-1
H.P. (1750 rpm.)....¼ to 15

SHAFT MOUNTED, GEAR REDUCERS—ELIMINATE SUPPORTING STRUCTURES END ALIGNMENT PROBLEMS

18 Models From Stock
Speeds.......8 to 425 R.P.M.
H.P..........Fractional to 120
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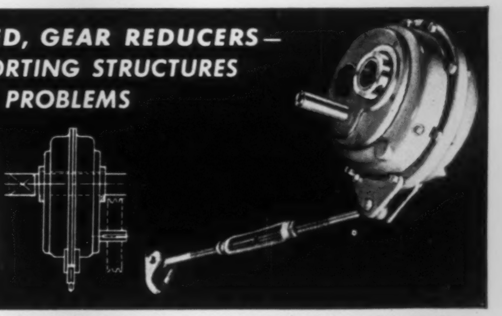
Hollow...Shafts 1 7/16 to 5 5/16 in.



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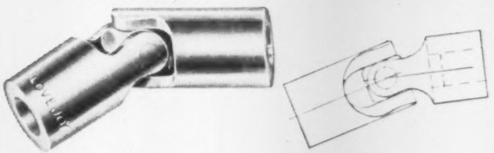

Bores..............¼" to 2"
Hub Dia. ....½" to 4"
Static Torque
340 to 130700 in.-lbs.
H.P. (100 rpm.).....½ to 207

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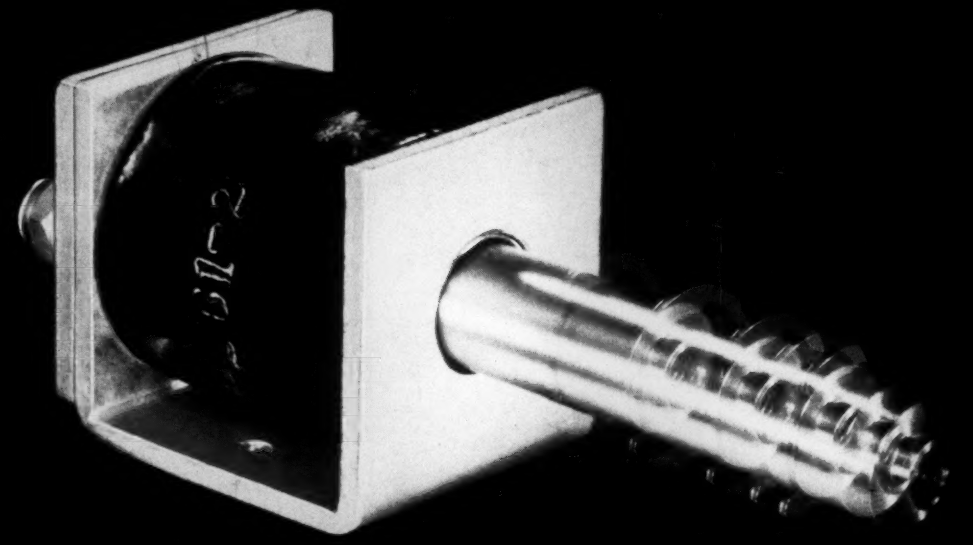
100 MILLION OPERATIONS!



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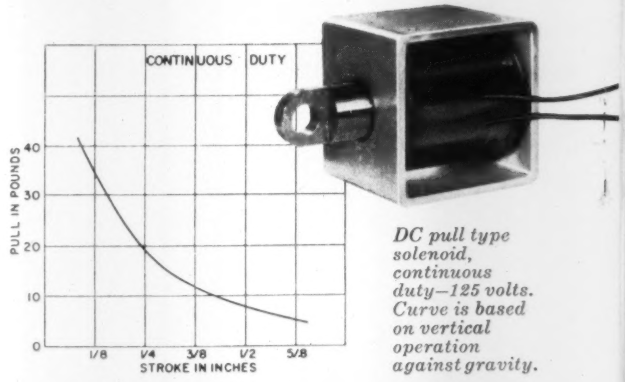

DC pull type solenoid, continuous duty—125 volts. Curve is based on vertical operation against gravity.

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